Chapter 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Prosser Creek Reservoir

Photograph by Jim Bailey

Stampede Reservoir

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CHAPTER 4 – CUMULATIVE EFFECTS

Chapter 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter provides background information on the study area and discusses the past cumulative effects of historical development on the study area's resources. It describes the resources that could potentially be affected by modifying operations of Truckee River reservoirs and the effects of the alternatives on these resources. Affected resources are surface water and groundwater resources, including water quality and sediment and erosion; biological resources, including endangered, threatened, and other special status species; recreation; economic, social, and cultural resources; and Indian trust resources. (See attachment H for additional perspective on Donner Lake.) Map 3.1 shows reaches of the Truckee River as they are designated in this document.

I. BACKGROUND

This section describes the setting, geology, and climate of the study area. These factors would not be affected by modifying operations of Truckee River reservoirs but could influence them.

A. Study Area Setting

The study area is located in the Great Basin, a 188,000-square-mile region that includes most of Nevada and portions of eastern California and western Utah. Great Basin stream systems drain internally instead of to an ocean. Streams in the Great Basin are generated from snowpack in high mountain ranges and terminate in sink areas that may contain lakes, wetlands, or playas.

The study area includes the 3,060-square-mile Truckee River basin in east-central California and northwestern Nevada, the Truckee Division of the Newlands Project (i.e., served by the Truckee Canal), Lahontan Reservoir, and 2,200 square miles of the lower Carson River basin in northwestern Nevada. (See location map.)

The Truckee River originates at the outlet of Lake Tahoe at Tahoe City, California, and flows about 120 miles to its terminus in Pyramid Lake, located within the Pyramid Lake Indian Reservation. Truckee River water is diverted at Derby Diversion Dam (located about 36 miles upstream of Pyramid Lake) via the Truckee Canal, according to Operating Criteria and Procedures (OCAP) for the Bureau of Reclamation's (BOR) Newlands Project. The Truckee Canal extends about 32 miles through the Truckee Division of the Newlands Project to Lahontan Reservoir, located in the Carson Division of the Newlands Project in the lower Carson River basin. Lahontan Reservoir also captures Carson River inflow.

The lower Carson River originates at the outlet of Lahontan Reservoir, flows about 50 miles through Lahontan Valley, and terminates in Carson Sink.

The Truckee River basin includes the area that drains naturally to the Truckee River and its tributaries, and into and including Lake Tahoe (Lake Tahoe basin) and Pyramid Lake. The crest of the Sierra Nevada mountain range forms the western boundary of the Truckee River basin, with elevations ranging between 5,000 and 10,000+ feet mean sea level (msl). The California portion of the study area is approximately 760 square miles and contains Lake Tahoe and El Dorado, Toiyabe, and Tahoe National Forests in portions of El Dorado, Nevada, Placer, and Sierra Counties. Population centers are Truckee, South Lake Tahoe, and Tahoe City.

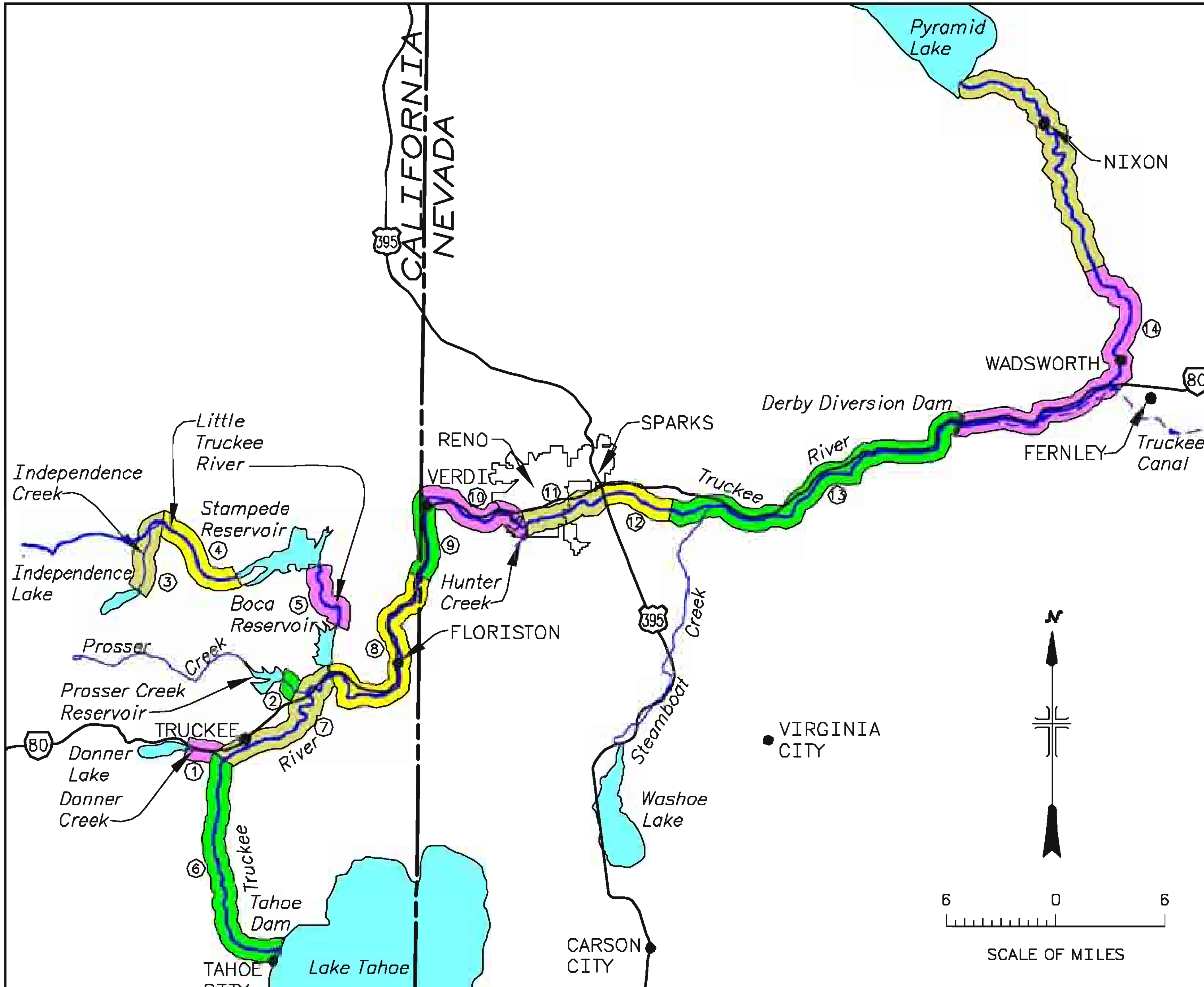
The Nevada portion of the study area includes one-third of the Lake Tahoe basin with its high alpine setting; the remainder is mostly a high desert that drops to an elevation of about 3800 feet near Pyramid Lake. The study area in Nevada includes parts of Churchill, Douglas, Lyon, Pershing, Storey, Carson City (only the rural portion) and Washoe Counties. Communities in the Lake Tahoe basin include Incline Village, Glenbrook, and Stateline. In the Truckee River basin, the Reno-Sparks metropolitan area (Truckee Meadows), located in Washoe County, is the principal population center; smaller centers include Fernley, Fallon, and Hazen, which are included in the study area but are not within the Truckee River basin. Approximately one-half of the study area in Nevada is Federal land, variously managed by BOR, Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS), and U.S. Navy. Naval Air Station Fallon (NASF) has a major flight training facility near Fallon.

The study area has three Indian reservations. The Reno/Sparks Indian Colony is located in Reno in an urban environment. The Pyramid Lake Indian Reservation surrounds Pyramid Lake and the lower reach of the Truckee River and includes the communities of Sutcliffe, Nixon, and Wadsworth. The Fallon Paiute-Shoshone Indian Reservation is near Fallon and includes lands adjacent to the Newlands Project. Additionally, the Washoe Tribe of Nevada and California holds interests in the Lake Tahoe basin.

Wetlands in the vicinity of the Truckee Canal—Massie and Mahala Sloughs and Fernley Wildlife Management Area (WMA)—are supported in part by drainage from the Truckee Division of the Newlands Project. Wetlands in the lower Carson River basin, such as Stillwater National Wildlife Refuge (NWR) and Carson Lake, are remnants of a once-extensive marsh system and are now supported in part by water rights and drain water from the Carson Division of the Newlands Project.

B. Watercourse of the Truckee River

The Truckee River originates at the outlet of Lake Tahoe, which is fed by 63 streams that drain the Lake Tahoe basin. It is one of the world's deepest lakes and is renowned for its clarity. Lake Tahoe Dam, on the northwestern shore at Tahoe City, controls the top 6.1 feet of the lake as a reservoir to store and release water for Floriston Rates. Floriston Rates, which are prescribed flows in the Truckee River, provide water to serve hydroelectric power generation, municipal and industrial (M&I) use in Truckee Meadows, instream flow, and numerous agricultural water rights. (See location map.)



EXPLANATION OF REACHES

1. Donner Creek: Donner Lake to Truckee River
2. Prosser Creek: Prosser Creek Reservoir to Truckee River
3. Independence Creek: Independence Lake to the Little Truckee River
4. Little Truckee River: Independence Creek to Stampede Reservoir
5. Little Truckee River: Stampede Reservoir to Boca Reservoir
6. Truckee River: Lake Tahoe to Donner Creek
7. Truckee River: Donner Creek to Little Truckee River Confluence
8. Truckee River: Little Truckee River to State line
9. Truckee River: State line to 3.2 miles downstream (Trophy)
10. Truckee River: 3.2 miles below State line to Hunter Creek (Mayberry)
11. Truckee River: Hunter Creek to U.S. Highway 395 (Oxbow)
12. Truckee River: U.S. Highway 395 to E. McCarran Blvd. (Spice)
13. Truckee River: E. McCarran Blvd. to Derby Diversion Dam (Lockwood)
14. Truckee River: Derby Diversion Dam to Pyramid Lake (Nixon)

REVISED DEIS/EIR
TRUCKEE RIVER OPERATING AGREEMENT
CALIFORNIA AND NEVADA

Map 3.1 Reaches of the Truckee River

AUGUST 2004

From Lake Tahoe Dam, the river flows north for about 15 miles to the town of Truckee, where it is joined by Donner Creek. Donner Creek is regulated by a dam on Donner Lake. Truckee Meadows Water Authority (TMWA) and Truckee-Carson Irrigation District (TCID) jointly own storage rights in Donner Lake.

About 1 mile downstream from Truckee, the river passes (and receives subsurface discharge from) the Tahoe-Truckee Sanitation Agency (TTSA) wastewater treatment facility. TTSA serves the Tahoe City Public Utility District, North Tahoe Public Utility District, Alpine Springs County Water District, Squaw Valley Public Service District, Truckee Sanitary District, and Northstar Community Services District.

About one-half mile downstream from TTSA, the river is joined by Martis Creek. Three miles further downstream, the river is joined by Prosser Creek. These creeks are regulated by the federally-owned Martis Creek and Prosser Creek Reservoirs, respectively.

Three miles downstream from Prosser Creek, the river is joined by its largest tributary, the Little Truckee River. The Little Truckee River is regulated by a dam on Webber Lake (privately owned) and by Stampede and Boca Reservoirs (federally owned). A tributary to the Little Truckee River, Independence Creek, is regulated by a dam on Independence Lake, which is owned by Sierra Pacific. About 5 miles downstream from the Little Truckee River confluence, Gray Creek enters the Truckee River; it is notable for discharging large quantities of mud and debris during heavy rains.

About 4 miles downstream from Gray Creek, the river enters Nevada near Farad, California, site of a key U.S. Geological Survey (USGS) stream gauge. Floriston Rates are measured at the Farad gauge. From Farad, the river passes the town of Verdi and flows east about 15 miles to Truckee Meadows. Sierra Pacific owns four hydroelectric plants along the Truckee River between the Little Truckee River and Truckee Meadows.

Truckee Meadows is a high desert valley bounded on the west by the Carson Range of the Sierra Nevada, on the east by the Virginia Range, and on the north and south by low hills. The Truckee River flows through downtown Reno, providing a setting for numerous municipal parks. Several small tributaries join the Truckee River in Truckee Meadows, the largest of which, Steamboat Creek, originates at the outlet of Washoe Lake and drains the southern and eastern parts of Truckee Meadows.

On the east side of Truckee Meadows at Vista, the river enters the Truckee River canyon. About 14 miles past Truckee Meadows, the river reaches Sierra Pacific's Tracy-Clark power station cooling ponds. About 4 miles past the ponds, the river reaches Derby Diversion Dam. Twenty miles downstream, the Truckee River enters the Pyramid Lake Indian Reservation and turns north at Wadsworth. The river flows for another 17 miles to Numana Dam, the diversion dam for irrigation on the reservation. About 8 miles downstream from Numana Dam is Marble Bluff Dam, which is designed to reduce erosion along the lower Truckee

River. Also at the dam, a fish lock, constructed in 1998, and the Pyramid Lake Fishway aid the migration of Pyramid Lake fishes.[1]

Pyramid Lake, the terminus of the Truckee River, is 30 miles long, 11 miles wide, and covers about 169 square miles at a surface elevation of 3800 feet msl. Immediately east of Pyramid Lake is the bed of Winnemucca Lake, which dried up in 1938.

At Derby Diversion Dam, Truckee River water is diverted to the Newlands Project via the Truckee Canal. The 32-mile canal provides irrigation water to lands near Fernley and Hazen in the Truckee Division and to Lahontan Reservoir for use in the Carson Division, on Fallon Indian Reservation, and on Stillwater NWR, a total of about 60,000 water-righted acres.

C. Geology

The current topography of the study area began to take shape about 25 to 40 million years ago. During that time, a block of granitic rock was tilted up on its east side to form the present-day Sierra Nevada. To the east, great faults broke the earth's surface, and volcanoes discharged lava and ash over much of the landscape. Uplifted, north-trending blocks formed mountain ranges, and downdropped blocks formed valleys.

By about 2 to 3 million years ago, volcanic activity had subsided, the climate was becoming predominantly cool and wet, great glaciers formed to the north, and lakes filled many of the valleys of the Great Basin. At times, the lakes expanded beyond their valleys and coalesced to form huge lakes. One of these lakes was Lake Lahontan, which covered much of northwestern Nevada and a portion of northeastern California. At its maximum stage, about 50,000 years ago, Lake Lahontan occupied about 8,500 square miles. About 10,000 years ago, the climate began to warm, precipitation decreased, and Lake Lahontan receded until only a few remnants of the lake—Walker Lake, Honey Lake, and Pyramid Lake—remain today.

The historical geology continues to have localized influence in the study area. Throughout the Truckee River corridor, the bedrock is variably volcanic, metamorphic, and, in the lower reaches, sedimentary. In the lower Truckee River basin, thick unconsolidated sedimentary deposits exist that have become deeply excised as the elevation of Pyramid Lake declined. Exposed tufa, calcium carbonate deposits that formed below the surface of the lake, provide evidence of a historically higher elevation.

Downstream from Lahontan Reservoir, the geology becomes a complex combination of deposits consisting of organic-rich clays, sands, and gravels. These sediments also contain varying amounts of salts, which is typical in an internally drained basin in which minerals remain after water evaporates.

[1] Federally endangered cui-ui and threatened Lahontan cutthroat trout (LCT) are collectively referred to as Pyramid Lake fishes.

D. Climate

The climate of the California portion of the study area is characterized by cold, wet winters and short, mild summers. The climate of the Nevada portion of the study area is typical of the Great Basin, with long, dry winters and short, dry summers.

In the Sierra Nevada, precipitation falls almost exclusively as snow from November to April (85 percent of annual precipitation). Most Truckee River runoff results from snow that accumulates on the eastern slope of the Sierra Nevada in the winter and melts in late spring and early summer. Summer thunderstorms are common but produce little precipitation. Lowest annual precipitation recorded at Tahoe City (elevation 6230 feet msl) was 9.34 inches (1976); highest annual precipitation was 66.41 inches (1996). Average annual precipitation is about 32 inches. Highest temperature recorded at Tahoe City was 94 degrees Fahrenheit (˚F) (August 1933); lowest recorded temperature was -16 ˚F (December 1972). Average August temperature is about 61o F; average January temperature is about 29 ˚F.

The Sierra Nevada also greatly influences the climate of the Nevada portion of the study area. The prevailing winds are from the west. As the warm, moist air from the Pacific Ocean ascends the western slopes of the Sierra Nevada, the air cools, condensation occurs, and most of the winter moisture falls as snow; but, as the air descends the eastern slope of the Sierra Nevada into Nevada, it warms, and very little precipitation occurs. Above 5000 feet, precipitation usually falls as snow. Lowest annual precipitation recorded at Reno (elevation 4397 feet) was 1.55 inches (1947); highest annual precipitation was 13.73 inches (1890). Average annual precipitation is about 7.5 inches.

Climate in the Nevada portion of the study area is semiarid to arid, and summers are characterized by clear, warm days and cool nights. Winters are not severe, with temperatures rarely dropping below 0 ˚F. Highest temperature recorded at Reno was 108 ˚F (July 2002); lowest temperature on record was -19 ˚F (January 1890). Average August temperature is about 70 ˚F; average January temperature is about 33 ˚F.

The historical hydrology of the study area is characterized by periods of droughts and flooding. Drought is a long period of abnormally dry weather affecting a relatively large area. The two most severe droughts on record occurred from 1928 through 1935 (average annual discharge at Farad of 303,240 acre-feet) and from 1987 through 1994 (average annual discharge at Farad of 286,350 acre-feet. The lowest recorded flow at Farad was 37 cubic feet per second (cfs) in September 1933.

Major flooding events occurred in 1907, 1909, 1928, 1937, 1950, 1955, 1963, 1983, and in January 1997. The “high water year” in the Truckee River basin is 1983, when Truckee River annual discharge recorded at the Farad gauge was 1,769,000 acre-feet (Nevada, 1997a).

E. Public Trust Doctrine

In California, the public trust doctrine has historically been referred to as the public's right to use California's waterways to engage in commerce, navigation, and fisheries. More recently, however, the definition of this doctrine has been expanded by the courts to include the use of California's water resources for environmental preservation and recreation; ecological units for scientific study; open space; environments which provide food and habitats for birds and marine life; and environments which favorably affect the scenery and climate of the area.

II. Past Cumulative Effects

This section describes the cumulative effects that settlement, logging, mining, and irrigation projects have had on the study area's resources. The discussion focuses on the period beginning with immigration from the eastern United States (about the mid-1800s) until the present. The first subsection provides an overview of past cumulative effects in the study area; subsequent subsections describe the cumulative effects of these changes on individual resources. Chapter 4 provides a discussion of the cumulative effects of future actions on the study area's resources.

A. Overview

1. Early Exploration and Settlement

Humans have inhabited the Lake Tahoe, Truckee River, and lower Carson River basins for more than 10,000 years. These early people depended on the abundant fish in the Truckee River, Pyramid Lake, and Stillwater Marsh for survival. In particular, cui-ui, a sucker fish found only in Pyramid Lake and the lower Truckee River, was a staple for people in this region; the Pyramid Lake Paiutes were called "Kuyuidikadi" or "cui-ui eaters."

Spanish explorers knew of the Truckee and Carson Rivers by the end of the 1700s, and trappers and traders first visited the study area in the late 1820s and early 1830s. The area was not systematically explored until John Charles Fremont, who was exploring the Rocky Mountains and northwest, arrived in 1844 from Oregon Territory with guide Kit Carson. Famed for his role as one of the first (post-Lewis and Clark) government-sponsored explorers, Fremont coined the descriptive term "Great Basin" as the vast stretch of semi-arid land between the Wasatch Mountains and Sierra Nevada. Fremont is also credited with naming Pyramid Lake after a prominent rock formation located near the east-central shore.

Following Fremont's expedition, more prospectors and settlers traversed the Sierra Nevada to California. With the 1848 discovery of gold at Sutter's Mill near Sacramento, the number of immigrants increased exponentially. While some established trading posts at river crossings along the Carson, Humboldt, and Truckee Rivers to supply the permanent settlers, most of the early settlers of the 1850s and early 1860s became ranchers or farmers.

2. Comstock Era

The Comstock era began in June 1859 with the discovery of gold near Virginia City, Nevada. Silver, however, eventually became the primary ore mined. As with most large-scale mining discoveries in the 19th century American West, the Comstock Lode precipitated a period of unprecedented growth and settlement. For more than two decades, the development and operation of Virginia City's mines influenced virtually every aspect of life in the study area.

This increased mining activity necessitated heavy water usage, so water was diverted from the Lake Tahoe and Truckee River basins. Additionally, demands for lumber to supply the mines and railroads led to extensive logging and milling operations. This economic activity adversely affected the environment: it denuded vast forest expanses, eroded barren hillsides, and clogged rivers and streams with sawdust and logging debris, which hampered fish migration and degraded water quality and had long-lasting effects on the study area's natural and cultural environment.

3. Lumber Era

Of the several industries developed in connection with the Comstock, none was more important or widespread than that of supplying lumber for construction purposes and for fuel. By 1861, there were three lumber mills in the study area that served the needs of settlers and prospectors. Most homes, businesses, mines, and mills were constructed primarily of wood. Lumber eventually could only be obtained from Sierra Nevada forests because the pinyon pines found in the desert mountains of the Virginia Range were quickly exhausted (Galloway, 1947).

Water was key to moving timber or finished lumber. Chutes took logs to Lake Tahoe (and holding ponds) from which they were floated to mills. Water flowing through flumes moved finished lumber, wood, and other materials produced by high mills down the mountains at remarkable speeds (Galloway, 1947). By 1880, there were 10 flumes in Douglas, Ormsby (present-day Carson City), and Washoe Counties (Hinkle and Hinkle, 1987).

As discussed in chapter 1, a private timber crib dam constructed in 1870 at the outlet of Lake Tahoe regulated flows in the Truckee River so that logs could be floated to sawmills in Truckee, California. The dam also was used for milling purposes and to generate hydroelectric power. The estimated value of lumber production for the 20 years before 1890 was $80 million, nearly the production total of all of the Comstock mines.

4. Railroads

In spring 1868, the western leg of the first transcontinental railroad, the Central Pacific, reached the California-Nevada border. Among the towns established during construction were Verdi, Boca, Reno, and Wadsworth (Hinkle and Hinkle, 1987; McLane, 1990). Reno was founded in May 1868 when the Central Pacific auctioned lots for a depot and yard to be used as a distribution point. Central Pacific construction supervisor Charles Crocker named Reno after Jesse C. Reno, a Union general killed during the Civil War.

From the new Reno depot, goods and passengers were delivered to the Comstock by road until the August 1872 completion of Virginia and Truckee Railroad, which linked Reno to Virginia City.

5. Farming and Ranching

Long before the arrival of the U.S. Reclamation Service (USRS), settlers in the study area created irrigation ditches. In 1861, construction began on the Pioneer and Cochran Ditches in Truckee Meadows, which provided water for hay meadows (Nevada, 1997a). As early as 1863, hay ranches were established in Truckee Meadows and Lahontan Valley (Raven, 1990). Settlers in the lower Carson River basin initially fed cattle driven from Texas or California on native hay and sold both the cattle and hay to Comstock residents.

Around that time, rock and brush diversion techniques for irrigation were introduced. These techniques allowed ranchers to water hay pastures, enlarging the areas used and speeding the transition from native grasses to alfalfa, introduced in 1864. By 1866, ranchers began to burn tule thickets and plow up and level the sagebrush areas to enlarge meadows and create irrigated pastures.

In Lahontan Valley, the system of open range and irrigated hay ranching grew, fueled by continuing demand from mining. As demand grew, however, competition for land and water increased as did the frequency of disputes. By the late 1870s, ranchers had fenced off much of the previously open range land (Townley, 1977).

In the 19th century American West, when one boom exhausted itself, another usually took its place. In the 1880s, as Comstock mining waned, the "Beef Bonanza" began; demand for beef at the national and international (mostly England) level was greater than supply. The prosperity from beef production in the 1870s and 1880s spawned other business development, including a flour mill in 1881 and an artesian well cooperative. Valley ranchers entered into contracts with stockmen from other locations to feed their cattle during the winter (Townley, 1977).

Then, during the extremely severe winter of 1889-90, more than one-half of the stock died. This created a ripple effect; creditors liquidated ranches not just in Nevada but throughout the West (Townley, 1977). In the early 1890s, extreme drought followed extreme cold, which diminished grasses on the public lands. Cattle competed with sheep, which had become very popular in the State, and with wild horses for forage. An 1893 bill passed by the Nevada Legislature provided for payment of 25 cents for each wild horse killed on public lands, a source of income to Indians and cowboys alike for decades (Townley, 1977).

6. Early Irrigation and Water Projects

Early settlers selected prime spots along drainages and diverted water for irrigating crops and pastures, with increasing reliance on irrigation. By 1879, increased water use throughout the region, combined with continued expansion of beef production, stimulated plans for water storage and, ultimately, for BOR projects (Townley, 1977). At that time, water to irrigate land in the Lahontan Valley was diverted directly from the Carson River, with limited supplies in late summer and fall as river flows declined.

It was not until 1902, however, that the Congress passed the National Reclamation Act, which created the U.S. Reclamation Service (renamed the Bureau of Reclamation in 1923).

That act authorized the Federal Government to construct irrigation projects in the West, to “reclaim” lands for widespread cultivation and settlement (Nevada, 1997a). On March 14, 1903, the Secretary of the Interior selected the Truckee-Carson Project (later renamed Newlands Project) as one of the first five such projects (Townley, 1977).

a. Newlands Project

With the authorization of what is now called the Newlands Project, USRS started to map the Truckee Canyon and selected the location for Derby Diversion Dam—the first USRS facility—completed in 1905. That accomplished, the surveyors moved east to map the route of Truckee Canal and lay out water supply and drainage ditches for 200,000 acres of arable land. In 1904, farmers moved onto various parcels of land; most were in six townships around Fallon, with others near the new town of Fernley. In 1906, the first project water was delivered to 108 ranches.

As USRS supplied water to an increasing number of parcels, it became apparent that the original estimates of available Truckee River flow and Lake Tahoe storage were too high. Thus, USRS decided in 1908 to build a storage reservoir on the Carson River. In February 1911, construction began on Lahontan Reservoir near Fallon. The 1914 completion of Lahontan Dam allowed land entry to resume with what was believed to be sufficient water, and from 1914-1917, hundreds of settlers arrived in Lahontan Valley.

Additionally, in 1908, after several changes in ownership, the Truckee River General Electric Company, predecessor to Sierra Pacific, signed an agreement with the Floriston Pulp and Paper Company to establish the first Floriston Rates. Between 1909 and 1913, USRS and the Truckee River General Electric Company replaced the original Lake Tahoe crib dam with a 17-foot vertical gate concrete slab structure. On July 1, 1915, the United States assumed control of the dam under the *Truckee River General Electric* Decree.

In 1915 distrust of USRS became so intense that entrymen considered organizing a militia to take control of the Newlands Project. Cooler heads prevailed, however, and, in 1918, TCID was organized with the goal of resolving dissatisfaction and management problems.

On December 31, 1926, a contract between TCID and BOR transferred management of the Newlands Project to TCID. This transfer, however, still did not solve water supply problems. In the drought years between 1921 and 1934, TCID purchased water from Donner Lake and occasionally pumped water from Lake Tahoe or Lahontan Reservoir.

In 1935, the Truckee River Agreement (TRA) was executed to modify Floriston Rates. TRA also prohibited removing water from Lake Tahoe for other than sanitary or domestic uses by any means other than gravity with proper approvals (Simonds, 1996).

b. Truckee River Storage Project

By the 1920s, farmers upstream of the Newlands Project who advocated increased storage formed the Washoe County Water Conservation District (WCWCD). The September 1935 appropriation for the Truckee River Storage Project authorized design of Boca Reservoir

(Townley, 1977). On February 11, 1937, BOR approved the design for the Boca facility and executed a repayment contract with WCWCD. In 1942, BOR turned the management of Boca Reservoir over to WCWCD.

In 1943, TCID and Sierra Pacific signed an indenture for water rights from Donner Lake. Currently, Sierra Pacific, which jointly owns the storage rights with TCID, manages its water for M&I in Truckee Meadows. TCID manages its water for an occasional lease to Sierra Pacific for use in Truckee Meadows or to serve irrigation rights in the Truckee Division.

7. Later Irrigation and Water Projects

In 1962, BOR completed Prosser Creek Dam and Reservoir, the first Washoe Project facility. Designed primarily to provide additional flood control storage for Truckee Meadows, the facility is also operated to help achieve Floriston Rates. Today, Prosser Creek Reservoir is operated for the benefit of Pyramid Lake fishes, flood control, and the Tahoe-Prosser Exchange Agreement (TPEA). Another Washoe Project facility, Stampede Dam and Reservoir, is operated for the benefit of Pyramid Lake fishes and for flood control. Stampede Reservoir also provides incidental recreational opportunities. It is the second largest reservoir in the basin and the only Truckee River reservoir with a hydroelectric plant, installed in 1988.

In 1971, the U.S. Army Corps of Engineers (COE) completed Martis Creek Dam and Reservoir for flood control. Because the dam leaks (mostly due to the nature of the valley soils it is built on), it provides only temporary flood storage.

In 1975, BOR completed the final Washoe Project facility, Marble Bluff Dam and Pyramid Lake Fishway.

8. OCAP and More Recent History

In 1967, BOR established the first Newlands Project OCAP. The 1967 OCAP placed a maximum allowable diversion of 406,000 acre-feet on the Newlands Project, and sought to limit Truckee River diversions to the Carson Division. Under the 1967 OCAP, diversion of Truckee River water solely to generate hydroelectric power at Lahontan Dam and at a generating station on the V Canal was halted to reduce diversions at Derby Diversion Dam. Reduced inflow to Pyramid Lake resulting from upstream diversions and diversions to the Newlands Project since the construction of Derby Diversion Dam had caused the lake elevation to drop nearly 80 feet in about 50 years.

In 1968, the Pyramid Lake Paiute Tribe of Indians (Pyramid Tribe) filed a lawsuit against Interior Secretary Stewart Udall claiming the 1967 OCAP allowed water to be wasted within the Newlands Project. The suit sought to improve Newlands Project efficiencies, thus reducing diversions at Derby Diversion Dam and increasing inflow to Pyramid Lake. In 1973, a more restrictive OCAP was implemented to maximize the use of Carson River water and to minimize the use of Truckee River water on the Newlands Project. OCAP was modified again in 1988, and most recently in December 1997 to recognize and respond to developing changes in Newlands Project irrigated acreage and land use.

In 1989, the Pyramid Tribe and Sierra Pacific negotiated the Preliminary Settlement Agreement (PSA) to change the operation of Federal reservoirs and the exercise of water rights of the parties to (1) improve spawning conditions for Pyramid Lake fishes and (2) provide additional M&I water for Truckee Meadows during drought periods.

As described in chapter 1, the Congress enacted Public Law (P.L.) 101-618 in 1990 to provide the direction, authority, and mechanism for resolving a number of disputes over water resources and water rights in the Truckee and Carson River basins. Among other actions, P.L. 101-618 directs negotiation of an operating agreement for Truckee River reservoirs (i.e., the Truckee River Operating Agreement [TROA]).

B. Past Cumulative Effects on Affected Resources

1. Water Resources

a. Surface Water

Before the mid-1800s, Lake Tahoe and Truckee River basin lakes and streams were unregulated. During particularly wet years, Truckee River flows were sufficient to feed Winnemucca Lake, adjacent to Pyramid Lake. However, after more than 30 years of diversion at Derby Diversion Dam, Winnemucca Lake dried up in 1938.

Before irrigation in the lower Carson River basin, the flow path of the unregulated Carson River was more dynamic than today, and the river channel frequently changed course during floods. For example, before 1861, the Carson River entered Carson Lake on the northwest side and exited from the northeast corner, flowing into Carson Sink through Stillwater Slough. Heavy Carson River runoff generally inundated parts of the lower basin in late winter and early spring. These waters accumulated in Lahontan Valley, supporting a complex system of open water and wetlands, including braided river channels, closed oxbows, perennial and ephemeral marshes, and playas (Nevada, 1997a).

Management of the reservoirs and diversions of water from the Truckee River have adversely affected Pyramid Lake. Before the early 1900s, fluctuations in the elevations of Pyramid Lake and Winnemucca Lake were primarily due to natural factors. After diversions for the Newlands Project began, elevations began a trend of decline and, by 1938, Winnemucca Lake (previously habitat for cui-ui and the site of a national wildlife refuge) was dry. Pyramid Lake reached its lowest historical elevation (3784 feet) in 1967, 80 feet below its overflow elevation into Lake Winnemucca. Lowered Pyramid Lake elevation and reduced streamflow over the past 98 years have caused formation of the Truckee River delta at Pyramid Lake (COE, 1995).

b. Groundwater

The configuration of the shallow aquifer (0 to 50-foot depth to water) in the Newlands Project area has changed since the introduction of large-scale water projects. In 1904, the table generally sloped away from the Carson River and Stillwater Slough. The aquifer was about 5 feet from ground surface near the river and slough and about 10 feet from the ground surface 1 to 2 miles from the river. From 1916 through 1928, an extensive drainage system was constructed to control the buildup of the shallow aquifer in the Newlands Project area by providing interception and discharge of groundwater to the valley sinks such as Carson Lake and Stillwater Marsh. Currently, there are about 350 miles of drains, 300 miles of irrigation laterals, and 68.5 miles of main canals.

The depth to water is more uniform today than it was in the past—5 to 10 feet throughout much of the area—a result of the continued contribution from irrigation recharge and canal seepage. Seasonal fluctuations of 1 to 3 feet are common with changes in irrigation cropping, water supply, and rainfall.

2. Water Quality

Surface water quality in the study area has diminished greatly since the mid-1800s, primarily as a result of population increases and industrial practices. Mining, lumbering, sawmills, livestock grazing, water projects, and even the 1960 Winter Olympics severely affected the quality of water in Lake Tahoe, the Truckee River, tributary streams, and Pyramid Lake.

Extensive logging and milling operations throughout the Sierra Nevada quickly and severely degraded the quality of the Truckee River and choked the rivers banks and bed with sawdust, even creating sawdust bars at the river’s terminus at Pyramid Lake, which proved impassable to fish attempting to spawn upstream. Moreover, flumes used to transport logs to the river were lubricated with tallow, dogfish oil, or rancid butter, much of which discharged to the river. Clearcutting of the forests in the basin to supply wood for mining timbers, railroad ties, and other development resulted in discharge of large amounts of sediment to the river, further degrading water quality (Nevada, 1997a).

Reno’s first sewer lines were built around 1868 and consisted of pipes connected with each storefront and then extended down alleys or streets to the Truckee River, where raw sewage poured directly into the river. During the summer when the stream channel frequently dried up, the area was rank with piles of untreated waste awaiting the fall rains to carry them away downstream. This condition existed well into the 1900s (Nevada, 1997a).

In 1880, Highland Reservoir began providing municipal and industrial water to the city of Reno. This open, unfiltered water system took water directly from the Truckee River by an open canal which was easily fouled by feedlots and decaying carcasses of range stock. Reno residents often complained that their municipal water “looks thick and nasty, and tastes and smells just as nasty as it looks, having the flavor of rotten wood, dead fish and general staleness” (Townley, 1983). Making matters even worse, a strainer at the reservoir outlet frequently came loose, admitting trout and other fish into the pipes, which, as the pipe diameters through the Reno water distribution network narrowed, subsequently turned them into infamous “Reno chowder” by the time they reached the kitchen sink (Nevada, 1997a).

In 1899, the Floriston Pulp and Paper Company, located at the present-day site of Floriston, California, began operations with the daily discharge of up to 150,000 gallons of acidic waste directly into the Truckee River. By 1903, the Truckee River’s water quality had deteriorated to the point where it was reported that the water at the Virginia Street bridge in downtown Reno consisted of a “blend between black and brown with soapy bubbles covering the surface” (Reno Evening Gazette, October 14, 1903). Despite court ordered injunctions and the threat of a Nevada suit filed with the U.S. Supreme Court, discharges continued until late 1930 when the plant ceased operations (Nevada, 1997a).

In 1962, an 8-inch secchi disc and a hydrophotometer test revealed that the disc was discernible in Lake Tahoe at a depth of 136 feet and light was detectable at 500 feet. In 1969, the secchi disc was visible at only 100 feet, equating to an annual 4 percent reduction in clarity (Report of the Lake Tahoe Joint Study Committee, March 1967, and Houghton 1994). By the 1980s, the disc was discernible at a depth of 75 feet (California, 1991). In recent years, clarity has varied. In 2002, the average discernible depth was 78 feet (University of California, Davis, February 25, 2003).

To eliminate the effect of numerous wastewater discharges on the water quality of Lake Tahoe, the Tahoe-Truckee Sanitation Agency was formed in 1972 to create a regional entity for collecting and treating wastewater from communities located along the northern and western shore of Lake Tahoe; Alpine Meadows, Squaw Valley, and Northstar Ski Resorts; and the town of Truckee and its environs (TTSA, 1999). Nutrients and organics were diverted from Lake Tahoe, thus reducing algal growth and improving water clarity.

Tributaries contribute sediments to the Truckee River, particularly during flood events. For example, the Gray Creek watershed is characterized by extremely steep terrain, unstable soil conditions, extensive logging, and overgrazing by livestock. On many occasions, mud flows from Gray Creek have caused the Truckee River to “run red” through Reno. An investigation of the Gray Creek watershed by the U.S. Forest Service (USFS) showed that little could be done to alleviate this periodic flood-related problem due to topographical, hydrological, and biological conditions (Joplin and Fiore, 1995).

Studies performed in 1991 concluded that agricultural runoff along the lower Truckee River approximated nutrient input from the Reno-Sparks sewage treatment plant (COE, 1995).

The Truckee River Water Quality Settlement Agreement (WQSA), signed in October 1996, establishes a joint program to improve water quality by increasing seasonal streamflows in the Truckee River downstream from Truckee Meadows through the purchase and dedication of Truckee River water rights for streamflow. Water associated with the exercise of water rights acquired pursuant to WQSA would be stored, when possible, in Prosser Creek and Stampede Reservoirs, and would be managed by the parties acquiring water rights under WQSA and by the Pyramid Tribe.

3. Sedimentation and Erosion

a. Truckee River Basin

Extensive logging and mining in the 1800s led to erosion of hillsides, causing severe sedimentation in the Truckee River and destabilization of the natural geomorphology. By the late 1800s, more than 60 percent of the mature trees in the Lake Tahoe basin had been cut down, resulting in extensive erosion and sedimentation problems in the tributaries to Lake Tahoe, including the Truckee River in Nevada (Nevada, 1997a).

In 1886, the Reno Reduction Works, an ore processing plant, was established. The mill discharged rock residue into the Truckee River, leading to sediment deposition.

In the lower Truckee River, the Truckee Canal has had profound effects on sedimentation and geomorphology. Pyramid Lake dropped more than 80 feet between 1905 and 1967, which caused a lowering of the base level of the Truckee River. Lowering the base level of the Truckee River resulted in higher sediment loads and an unstable channel downstream from Derby Diversion Dam. The high sediment loads greatly increased the size of the Truckee River delta, and the lowermost reaches of the river became incised. Sedimentation of the delta was so great that the cui-ui's ability to cross the delta to access the river was greatly impeded. Marble Bluff Dam and Pyramid Lake Fishway are designed to reduce erosion along the lower Truckee River and to aid migration of Pyramid Lake fishes, respectively.

The construction of Boca Dam probably resulted in increased sedimentation and erosion on the Little Truckee River. Prosser Creek Dam, Stampede Dam, and Martis Creek Dam have greatly reduced floods on the Truckee River, which has resulted in decreased sedimentation and erosion. However, other factors have offset the benefits of these dams, including the large population increases in Reno and surrounding areas and urbanization, which results in increased runoff, channel degradation, and erosion.

COE stream channel work conducted in the Truckee River in the 1950s, including clearing and straightening, accelerated sedimentation and erosion in many reaches (COE, 1992). The greatest effects occurred in the reach between Wadsworth and Pyramid Lake, where straightening steepened the channel, causing it to be less resistant to high flows. As a result, a 1963 flood caused extensive flooding and erosion.

In 1974, to improve conveyance of Truckee River water in Reno and downstream, COE removed reefs near Vista (Nevada, 1997a), and several wetlands were drained in the eastern portion of Truckee Meadows, resulting in erosion in Steamboat Creek.

In 1992 and 1995, localized rainstorms on Gray Creek resulted in the discharge of extensive quantities of sediment to the Truckee River (Nevada, 1997a). Studies concluded that little could be done to control erosion in the watershed because of topographic, hydrologic, and geologic conditions.

Then in January 1997, a record peak flood flow, the result of a rain-on-snow event, occurred in the Lake Tahoe basin (Rowe et al., 1999). The water elevation of Lake Tahoe rose more than one foot, reaching its highest level since 1917, at elevation 6229.4 feet. The high water level, along with strong winds, resulted in extensive erosion and sedimentation at the lake and in the upper Lake Tahoe basin.

b. Carson River Basin

Development of the Newlands Project and diversion of Truckee River water through the Truckee Canal changed the geomorphology of the lower Carson River. The widely varying hydrologic regime instead became a regulated flow condition with hundreds of miles of irrigation channels.

In 1970, USGS sampled sites in the Carson River basin downstream from the Comstock era mines and identified elevated mercury concentrations in unfiltered river and sediment. High concentrations of mercury also were found in the sediments and fish of Lahontan Reservoir, downstream from the reservoir on the Carson River, and at Stillwater WMA (Nevada, 2003).

In 1990, the U.S. Environmental Protection Agency (EPA) listed the Carson River Mercury Site, which includes approximately 100 miles of the Carson River and Stillwater NWR, on its National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act (55 Federal Register [FR] 35502-35512, August 30, 1990). Research is ongoing, and minor cleanup of the area has occurred. By 1994, EPA identified that health risks were most evident from fish and wildlife and sediment throughout the Carson River basin, including Lahontan Reservoir, the active channel of the Carson River, Carson Sink, and Stillwater NWR (Nevada, 1997b).

In January 1997, a flood flow in the Carson River peaked at 22,300 cfs (measured at the Fort Churchill gauge). The river carried an estimated 200,000 tons of sediment and 1.5 tons of mercury, representing nearly 33 percent of the total sediment load and 30 percent of the total mercury load estimated to have passed the gauging station during the 9-month sampling period from January through September 1997 (Hoffman and Taylor, 1998).

4. Biological Resources

a. Pre-settlement Conditions

i. Truckee River Basin

Before the mid-1800's, many portions of the free-flowing Truckee River and its tributaries were bordered by marshes and stands of willows. Marshy lowlands covered the eastern third of Truckee Meadows, which was vegetated with thick stands of grasses, bulrushes, and cattails. A natural rock formation at Vista partially constricted river flow so that high water during the spring runoff inundated an extensive area. Wetlands with dense stands of willows bordered the river, and abundant cottonwoods grew on slightly higher ground (Nevada, 1997a). The river meandered through Truckee Meadows, and islands were covered with thick stands of willows, cottonwoods, currant, and wildflowers (McQuivey, 1996, as cited in

Nevada, 1997a). The lower Truckee River had extensive groves of large cottonwoods forming dense thickets (Ridgway, 1877). Historically, 450 acres of palustrine emergent wetlands and 7,700 acres of riparian (both shrub and forest) vegetation occurred along the river downstream from Vista (COE, 1992) in bands up to 2,000 feet wide (COE, 1995).

The Truckee River teemed with fish. Large numbers of Lahontan cutthroat trout (LCT), a fish of "extraordinary size" (Fremont, 1845, as cited in Nevada, 1997a), traveled from Pyramid Lake to the tributaries of Lake Tahoe and Donner Lake to spawn (Gerstung, 1988; Nevada 1995). Cui-ui inhabited both Pyramid Lake and Winnemucca Lake and spawned in the Truckee River, likely hundreds of thousands, up to what is now Wadsworth (Buchanan and Coleman, 1987). Pyramid Lake reached an elevation as high as 3878 feet (Galat et al., 1981) and, in some years, the Truckee River flowed into adjacent Lake Winnemucca.

Bird life was also plentiful and diverse. In 1868, naturalist Robert Ridgway identified 107 species of birds along the Truckee River downstream from Wadsworth (Ammon, 2002a). Thousands of pelicans, gulls, ducks, geese, and other waterfowl used Pyramid Lake (McQuivey, 1996, as cited in Nevada, 1997a), and Lake Winnemucca supported large numbers of waterfowl as well. Duck Lake, located just south of Pyramid Lake, was at times literally covered with mallard, teal, and coots; snipe were found along the shore (McQuivey, 1996, as cited in Nevada, 1997a). Bald eagles nested at Pyramid Lake as late as 1866 (Alcorn, 1988) and at Lake Tahoe.

ii. Carson River Basin

Cottonwoods lined the banks of the Carson River where it entered Carson Lake. The river supported large populations of trout and other fish, and Carson Lake supported fish, mussels, and other aquatic life (Simpson, 1876, as cited in FWS, 1996). In 1862, a flood event changed the river course so that it flowed directly into Carson Sink, and Carson Lake shrank (Nevada, 1997b). The maximum size of the lake and adjacent marsh was about 38,000 acres, with an average of 27,000 acres. Stillwater Marsh and Carson Sink averaged about 120,000 acres.

An estimated 150,000 acres of wetland habitat existed in Carson Lake, Stillwater marshes, and other terminal wetlands in Lahontan Valley between 1845 and 1860 (Kerley et al., 1993). In the late 1800's, Carson Sink was "half shallow lake, half tule swamp" and supported salt grass, sedges, and tules (Nevada, 1997b). There was an abundance of submergent vegetation, bulrush, sedges, and salt grass in Stillwater Marsh and Carson Sink. Freshwater clams and aquatic snails, fish, mink, and river otter were present and used by the native people. Frogs, muskrats, pelicans, curlews, other shorebirds, ducks, geese, and other aquatic birds were abundant (Kerley et al, 1993).

b. Post-Settlement Conditions

Since the 1850s, the Truckee and Carson River basins have been affected by a multitude of competing interests. Man has actively sought and exploited resources in the area—timber, ore, land, water, wildlife, and scenery. The following narrative highlights past cumulative effects that have led to conditions that exist today. Changes associated with lakes and reservoirs and changes along the rivers and streams of the study area are discussed.

i. Lakes and Reservoirs

(a) Lake Tahoe and Truckee River Basins

With the arrival of settlers in the Truckee River basin, aquatic, wetland, and riparian communities began to change. Reconstruction of dams at Lake Tahoe (1913), Donner Lake (1930s), and Independence Lake (1939) created more aquatic habitat but reduced upland and riparian vegetation adjacent to the natural shoreline (by approximately 1,865 acres at Tahoe, 155 acres at Donner Lake, and more than 50 acres at Independence Lake). These and earlier dams created migration barriers for fish, and operations changed river flow patterns with far-reaching consequences. Loss of riparian vegetation by inundation likely reduced bird and small mammal populations. Inundation of Tahoe yellowcress habitat and impacts from recreation and development resulted in listing of the plant by the State of California in 1982 as endangered and by the State of Nevada as critically endangered. Human disturbance, including timber harvesting and development at and near the lakes, cumulatively have had far-reaching adverse effects on forest and riparian vegetation and associated wildlife.

Construction of Boca (1937), Prosser Creek (1962), Stampede (1970), and Martis Creek (1971) Dams and associated reservoirs further altered the environment, creating additional aquatic habitat at the expense of terrestrial valleys and their associated riparian and stream ecosystems. Losses at the reservoirs were approximately 980 acres of Jeffrey pine forest, sagebrush, and willow/aspen/meadow riparian habitats and about 4.7 miles of stream for Boca Reservoir; 3,450 acres of Jeffrey and lodgepole pine forest, sagebrush, and willow/meadow riparian habitats, 8.7 miles of streams and sloughs of the Little Truckee River, 3.7 miles of Sagehen Creek, and 7.6 miles of tributaries to the Little Truckee River for Stampede Reservoir; 750 acres of sagebrush and riparian habitats, 4 miles of Prosser Creek, 2 miles of Alder Creek, and 1.6 miles of tributaries to Prosser Creek for Prosser Reservoir; and several miles of stream and riparian habitats for Martis Creek Reservoir.

The valleys had historically provided biologically rich areas for riverine and terrestrial wildlife and were likely important movement corridors. Construction of the reservoirs likely adversely affected amphibians, many species of migratory songbirds, waterfowl, water shrews, Sierra Nevada mountain beaver, muskrat, mink, and otter. Although some of these species may use the reservoirs to a limited extent, the reservoirs do not provide quality habitat. Some reservoirs have likely increased habitat for some species of spring and fall migrating waterfowl.

Construction of the reservoirs resulted in a shift in composition of fish communities from river- to lake-oriented. Resource agencies have stocked and continue to stock non-native fish in lakes and reservoirs for recreational fishing in response to depleted native fish populations. In 1887, the first (recorded) Mackinaw (lake) trout (non-native) was introduced into Lake Tahoe (Nevada 1997a). A non-native invertebrate (*Mysis relictus*) also was stocked in Lake Tahoe from 1963 to 1965 to enhance the prey base for lake trout. These introductions have likely disrupted native communities and increased predation on native fishes, amphibians, and macroinvertebrates (Goldman et al., 1979; Frantz and Cordone, 1970; Panik and Barrett, 1994; Knapp, 1994).

The noxious weed, Eurasian watermilfoil, has become established in shallow waters of Lake Tahoe. This species can form thick underwater stands and dense mats near the water surface (University of Nevada, Reno, no date). It crowds out native plants and modifies aquatic ecosystems. The non-native common mullein has invaded the drawdown areas of several local reservoirs, particularly Stampede Reservoir, and may provide a source of seed to spread to other areas.

Timber harvesting during the Comstock era and, more recently, pesticide use likely have contributed to a decline in raptor populations, particularly osprey, peregrine falcon, and bald eagle, around the lakes. Bald eagles and osprey have recently re-established territories at some of the reservoirs. A self-sustaining population of kokanee (non-native fish) provides a winter food source for bald eagles at Lake Tahoe.

Marinas, residential areas, boat docks, trails, and roads have directly reduced riparian habitat and wetlands around the lakes and reservoirs. In particular, construction of Tahoe Keys Marina reduced the largest Lake Tahoe wetland from an estimated 1,350 acres to approximately 500 acres. This impact likely reduced populations of muskrat; fish; yellow-headed, red-winged, Brewers blackbirds and other songbirds; rails; and waterfowl. Use of these facilities has increased water consumption, disturbed wildlife, created nonpoint source pollution, and contributed to air pollution (which may degrade water quality).

Cui-ui was listed as endangered in 1967 under a predecessor to the current Endangered Species Act. The lowering of Pyramid Lake's elevation impeded access to the Truckee River, and flows frequently did not provide suitable conditions for cui-ui spawning and incubation. The original strain of LCT in Pyramid Lake became extirpated by 1944 (FWS, 1995b), due in part to overfishing and pollution, but primarily due to barriers to migration. A different strain of LCT was introduced to the lake in 1950, but dams and weirs prevented migration and lack of habitat in the lower river precluded spawning. Impacts to LCT throughout its range led to its being listed as an endangered species in 1970 (35 FR 13520, August 25, 1970), with reclassification as a threatened species in 1975(40 FR 29863, July 16, 1975). As stated previously, a fish lock at Marble Bluff Dam aids in river access for cui-ui and LCT during their annual spawning migration from PyramidLake. Marble Bluff Dam also routes streamflow through the Pyramid Lake Fishway; the fishway provides river access for cui-ui and LCT.

The initial recovery plan for cui-ui was written in 1978; since then there have been three revisions, most recently in 1992. A recovery plan for LCT was written in 1995. Both plans specify recovery criteria for the species and objectives designed to protect them, with the ultimate objective of delisting. In 1982, the U.S. District Court for the District of Nevada ruled that the Secretary must utilize all Project water stored in Stampede Reservoir for the benefit of the Pyramid Lake fishes until the cui-ui and Lahontan cutthroat trout are no longer threatened or endangered, or until sufficient water for their conservation becomes available from other sources.

Changes to Pyramid Lake have affected other species as well. Several species of aquatic snail in Pyramid Lake have become extinct (LaRivers, 1962). Furthermore, salinity of the lake increased 32 percent between 1933 and 1980; high salinity may substantially reduce species diversity of the crustacean zooplankton community (Galat and Robinson, 1983). Increased flows to the lake in the past few years, however, have reduced salinity levels (Scoppettone, 1999).

The Truckee River delta at Pyramid Lake currently provides some habitat for shorebirds and waterfowl; the lake may have historically supported much larger populations. Winnemucca and Duck Lakes, which supported large waterbird and shorebird populations in the early 20th century, have dried up (Nevada, 1997a).

Adverse cumulative impacts have led to an increased awareness by the public and government agencies of the value of these ecosystems and to programs to restore them. This culminated in the President, at the Lake Tahoe Presidential Forum in 1997, directing his Administration to begin acting on recommendations to improve water quality of Lake Tahoe and restore forest ecosystems. These projects have begun through development and implementation of the Lake Tahoe Environmental Improvement Program (EIP), and include such activities as stream restoration, erosion control, prescribed burns, and retention of large conifers to restore old growth forest or healthy forest characteristics. See Chapter 4, "Cumulative Effects," for future projects under the Lake Tahoe EIP. Forest restoration actions benefit the Truckee River and associated lakes and reservoirs by reducing the potential for catastrophic fire that could indirectly increase discharge of sediment to water bodies.

(b) Carson River Basin

Construction of the Newlands Project altered the natural hydrologic regime in Lahontan Valley, especially the wetlands (FWS, 1995a). Lahontan Reservoir inundated approximately 14,800 acres of sagebrush, saltbrush scrub, cottonwood forest, willow riparian, and marsh habitats, as well as approximately 12 miles of the Carson River. Nesting habitat for herons, egrets, and songbirds, and habitat for other riparian species that existed along the Carson River were inundated.

Islands in Lahontan Reservoir have provided nesting habitat for colonial nesting birds, including California and ring-billed gulls; reservoirs also attracted fish-eating birds such as terns, gulls, and pelicans which do not typically forage in riverine environments. Lahontan Reservoir has been used extensively during waterfowl migrations (Saake, 1994).

ii. Rivers and Tributaries

(a) Truckee River Basin

Dams at Lake Tahoe, Donner Lake, Independence Lake, and on the Little Truckee River, Prosser Creek, and Martis Creek have altered streamflows and flow patterns in the Truckee River and its tributaries.

Some of the greatest effects of dams have been incision of the river channel, narrowing of the flood plain, destabilization of riverbanks, loss of riparian vegetation and wildlife, interruption of migration corridors for spawning native fish, changes in the natural flow regime, and streamflows inadequate to support native invertebrates and fish. Fish can be trapped and killed by unscreened diversions. Movement of sediment also has been interrupted by dams. Sediment is important in the formation of gravel bars, which are highly productive invertebrate areas and provide habitat for fish spawning and egg incubation. Vegetative growth on point bars helps to narrow and deepen the stream channel, thereby providing cooler water and improving fish habitat.

In 1998, the Nevada State Engineer approved applications by the Pyramid Tribe to appropriate a maximum of 6,000 cfs of unappropriated water of the Truckee River and its tributaries, in part for spawning and conservation of cui-ui and LCT. This water has benefits for other aquatic life as well.

As discussed under “Water Quality,” mining, logging and sawmill operations, and other practices in the late 19th century led to severe degradation of water quality in the study area. Currently, streamflow reductions and alterations, loss of riparian vegetation that shaded the river, discharge of treated sewage effluent, and agricultural runoff promote degraded water quality and increased water temperature in the Truckee River. High seasonal water temperatures in the lower river preclude LCT and other salmonid species and, during summer months, often increase fish mortality. Invertebrate prey species for trout (mayflies, caddisflies, and stoneflies), which are indicators of good water quality, generally decline in the lower reaches of the Truckee River during many years.

Construction of Interstate 80 along the river corridor (1953 to 1979); construction of the Central Pacific Railroad in the 1860s, and later straightening of the corridor by Southern Pacific Railroad; urban development in Truckee, Reno, and Sparks; livestock grazing; construction of bridges; sand and gravel mining; river channel modification by COE for flood control in the 1960s; and clearing of vegetation cumulatively have had adverse effects. These actions eliminated many of the natural meanders of the Truckee River, altered sediment loads that provided fish spawning gravels, eliminated oxbows and wetlands, reduced periodic flooding of wetland vegetation, restricted channel migration, and eliminated an extensive riparian area.

By 1992, approximately 390 acres of palustrine emergent wetlands and 6,680 acres of riparian (both shrub and forest) vegetation that historically occurred along the Truckee River downstream from Vista had been eliminated, a result of clearing for agricultural and urban use, and cutting for firewood. Only about 60 acres of wetland and 1,020 acres of riparian vegetation remain (COE, 1992). Water management altered streamflow patterns to the degree that cottonwood regeneration was all but precluded (COE, 1995). The presence of beaver, thought to have been introduced to the Truckee River basin by USFS in the early 20th century to control erosion at the headwaters (Hall, 1960), and livestock have further reduced cottonwood survival in some areas.

In the early 1980s, FWS began to develop and implement a flow management strategy for the lower Truckee River to benefit cui-ui recovery. That strategy utilized a flow regime (and related selection criteria) to supplement unappropriated water in the lower river with project water in Stampede and Prosser Creek Reservoirs to "maximize occurrence of suitable river stages and lake conditions during spawning runs." Generally, in years when sufficient water was forecast to be available to promote cui-ui spawning and recruitment, project water would be released as necessary during April through June to assist in achieving prescribed flows. An evaluation tool ("cui-ui model") was developed to be used in conjunction with the Truckee River operations model to evaluate the relative benefits to the cui-ui population of various water management scenarios for the Truckee River basin. The cui-ui model provided the analytical basis for cui-ui in the 1998 draft environmental impact statement/ environmental impact report (DEIS/EIR). FWS has since replaced the cui-ui flow regime, which was a single-species strategy, with an expanded set of flow regimes that is intended to broaden the use of project water and other dedicated waters to provide recovery benefits for both cui-ui and LCT and the riverine habitat upon which they depend.

Water diversions, poor water quality, overfishing, and the loss of wetlands and the cottonwood riparian forest are major factors that have affected native fish and wildlife. In the 1860s, both settlers and Indians were fishing on the Truckee River and at Lake Tahoe for profit and recreation. Immense numbers of LCT were caught and shipped to San Francisco and mining camps (Sigler and Sigler, 1987). Later, canning plants were constructed along the river to process the fish. Between 1873 and 1922, up to 100 tons of LCT were harvested annually from Pyramid Lake and the Truckee River (Townley, 1980, as cited in Nevada, 1997a). Weirs and dams constructed in the river restricted LCT and cui-ui from reaching spawning grounds and facilitated harvest.

In the latter half of the 19th century, the large amounts of sawdust and debris from upstream lumber mills that created the delta at the terminus of the Truckee River further restricted these spawning migrations and contributed to the decline of the LCT population. Construction of the Newlands Project in 1905, which created an additional barrier at Derby Diversion Dam and diverted water from the river to the Lahontan Valley via the Truckee Canal, resulted in an eventual decline of Pyramid Lake.

Rainbow trout were first stocked in the river in California in 1879, brown trout in 1941, and kokanee in 1951. Catfish, rainbow trout, and brook trout were introduced to the Truckee River in Nevada in the 1870s and 1880s and, after 1890, the Truckee River was stocked annually to satisfy the demand of sport fishing (Nevada, 1997a).

A 1972-76 bird study along the lower Truckee River (Klebenow and Oakleaf, 1984) showed that 42 of the 107 species identified by Ridgway in 1877 were not present. A 1992-93 survey rarely detected marsh wren, savanna sparrow, or common yellowthroat, and American bittern and sora were not observed at all (Morrison, 1992a; 1993). Surveys in 1998 found 80 species, but some were non-native and others were not present in Ridgway's time. The net species loss between 1868 and 1998 was 47 percent, and several important habitat types were no longer present or were underrepresented (Ammon, 2002a). Declines in species diversity and abundance had occurred and are probably occurring in the amphibian (Panik and Barrett, 1994) and mammalian communities as well. However, as the result of cottonwood regeneration following favorable conditions in 1983 and 1987, and since restoration of cottonwoods along the lower river was begun in 1995, populations of some species of birds have substantially increased in abundance (Rood et al., 2003).

A major factor that has influenced native fish and wildlife communities is introduction of exotic species (including tamarisk, broad-leaved peppergrass, whitetop, purple loosestrife, Russian thistle, bullfrogs, non-native fishes, and several aquatic invertebrates). Non-native trout and bullfrogs consume young of native fishes and amphibians. Whitetop has overrun native habitats and currently is believed to cover about 12,000 acres along the Truckee River and its tributaries (Donaldson, 1999). Purple loosestrife has been found along approximately 49 miles of the Truckee River downstream from Reno (O'Brien, 1999). Eradication programs are currently being implemented to eliminate whitetop and purple loosestrife. Eurasian water milfoil has been found along 9 miles of the Truckee River downstream from Lake Tahoe and in a pond at Verdi (Donaldson, 1999).

In recent years, attention has focused on enhancing streamflows in the Truckee River, which directly or indirectly would benefit fish and other aquatic life. In 1995, FWS expanded its cooperative effort with the Federal Water Master to manage reservoir releases to promote establishment of cottonwoods along the river, particularly downstream from Derby Diversion Dam. The effort has been successful, and millions of cottonwood seedlings have become established along the lower river (Rood et al., 2003). In 1996, the Truckee River Water Quality Settlement Agreement was signed, which will increase seasonal streamflows in the river and, secondarily, will improve habitat for aquatic life. Also see "Water Quality." Other actions designed to improve conditions for fish have been implemented, including the fish lock at Marble Bluff Fish Facility, which can pass 800,000 cui-ui during a spawning run.

Other efforts include those of The Nature Conservancy to restore reaches of the Truckee River downstream from Vista and the Truckee River Watershed Council, which is assisting others in acquiring funds for restoration projects along the Truckee River and tributaries in California. These ongoing efforts are described in more detail in chapter 4.

Currently, the Pyramid Tribe is implementing a management plan that includes water quality monitoring in the Truckee River, riparian restoration measures along the lower river, and several measures from the Cui-ui Recovery Plan. It has implemented a fencing program to reduce streambank damage from livestock and improve cottonwood regeneration between Wadsworth and Pyramid Lake.

(b) Carson River Basin

During the Comstock era, milling operations in the Virginia Mountain Range and along the Carson River used mercury to process gold and silver ore. As much as 7,500 tons of elemental mercury may have been discarded in mill tailings or discharged to the Carson River or its tributaries (Bailey and Phoenix, 1944). This mercury flushed downstream; mercury has been found in sediment, water, and fish in Lahontan Reservoir, Carson Sink, and Stillwater NWR. (See "Sedimentation and Erosion.")

Diversion of Carson River water for agriculture reduced and modified the pattern of flow available to Lahontan Valley wetlands; this resulted in drying of marshes at Stillwater NWR, Carson Lake, and Carson Sink (Kelly and Hattori, 1985; Morrison, 1964; Townley, 1977, all as cited in FWS, 1996). Kerley et al. (1993) described changes in local wetland conditions, as summarized here. Wetland acreage in Lahontan Valley has been 10 percent of that documented in 1905. From 1967 to 1986, Carson Lake wetlands averaged 10,000 acres, and Stillwater Marsh wetlands averaged 14,000 acres. During the drought of 1987-1994, wetland acreage dropped to a low of about 2,400 acres (FWS, 1995a). Following the drought, the baseline wetland habitat in Lahontan Valley totaled about 16,600 acres in 1995 and 59,000 acres in 1997 (Henry, 1999).

Since construction of the Newlands Project, wetlands have been partially maintained with drainwater, which can contain contaminants. Sediments from some wetlands contained elevated concentrations of arsenic, lithium, mercury, molybdenum, and zinc. Biological tissues from some wetlands also contained elevated concentrations of materials associated with adverse biological effects on wildlife, particularly migratory birds. In most years, the water discharges were too low to flush these accumulated substances from the wetlands (FWS, 1996). TCID currently operates Lahontan Reservoir with flood flow criteria, and spills and precautionary drawdowns are directed first to wetlands and then to farmland.

Section 206 of P.L. 101-618 authorizes the acquisition of water and water rights for wetlands in Lahontan Valley. In 1990, FWS initiated a series of programs to acquire from willing sellers up to 75,000 acre-feet of water rights for the wetlands: 50,000 acre-feet from the Carson Division and additional water that may come from segment 7 of the Carson River, reservoir spills, drainwater, and other sources. As of June 2003, 32,800 acre-feet had been purchased in the Carson Division, 4,300 acre-feet from segment 7 of the Carson River, and 2,900 acre-feet acquired from the Navy. Most purchases have occurred at the edges of the Newlands Project near Stillwater NWR and Carson Lake (Grimes, 2003).

FWS has developed a comprehensive plan to manage Stillwater NWR that focuses on approximating natural habitat conditions as the primary means to conserve and manage refuge wildlife, restore natural biological diversity, and fulfill international treaty obligations with respect to fish and wildlife. The boundary of the refuge would be expanded to include a majority of the lands now within Stillwater WMA and portions of Fallon NWR, as well as land along the lower Carson River and other lands north of the existing refuge (FWS, 2003).

The expansion of agriculture in the valley, made possible by the Newlands Project, has eliminated approximately 74,500 acres of desert salt bush scrub, riparian, and wetland communities, which provided habitat for wildlife, and replaced it with fields of alfalfa and other crops. Agricultural fields provide foraging habitat for some wildlife, however, such as white-faced ibis. Residential housing, subdivisions, and commercial and industrial development have increased in Lahontan Valley in recent years. These developments have eliminated agricultural and wild land, including wetlands and riparian areas, thereby reducing habitat used by wildlife. Fallon NWR (1931), Stillwater WMA (1948), and Stillwater NWR (1991) were established for wildlife in the area.

5. Economics and Social Environment

Before 1850, the primary economic activities in the Truckee River basin were concentrated in trading posts and stop-off stations for travelers moving west to California and Oregon, although some ranching and farming also occurred. Two events that brought about significant economic development in the area were the discovery of Comstock Lode in 1858 and the development of the intercontinental railroad in the 1860s. These events attracted workers, miners, and entrepreneurs into the area. With the development of mining and the railroad, the demand for lumber and agricultural products greatly increased, which accelerated the growth in the lumber mill and agricultural sectors in the regional economy from 1860 to 1880.

Alfalfa seed, also known as “Chili clover,” was introduced to Truckee Meadows agriculture in 1868. Farmers soon planted it extensively, as it tolerates salt, variable climate, drought, and insects. By the mid-1870's, it was the staple crop.

When the Comstock fortunes began to fade in the early 1880s, a 20-year depression in Nevada began. Although this depression eventually caused the State’s population to fall by 32 percent, from 62,226 in 1880 to 42,355 by 1900 (Nevada, 1997a), the railroad and agriculture fostered development in Truckee Meadows.

From 1890 to 1920, the demand for agricultural goods increased. To help meet this increased demand, the Newlands Project was constructed to provide additional water for irrigation in Lahontan Valley.

During the 1890s, Floriston Pulp and Paper Company, Truckee River General Electric Company, Washoe Power and Development Company, and Reno Power, Light and Water Company, were taking water from the Truckee River to produce the newly popular electrical energy (Townley, 1977). It was also around this time that tourism trade began to grow in the Lake Tahoe area. (See “Recreation.”)

During the Depression years, gambling was legalized in Nevada, which helped to sustain the local economy. In the latter part of the 1930s, Federal legislation was approved for the development of additional water storage under the Truckee Storage Project.

During World War II, there was considerable economic growth due to the development of military installations, such as a pilot training station near Fallon and a munitions depot near Hawthorne.

The regional economy grew during the 1950s and 1960s, primarily in the mining, gambling, and tourism industries. In the 1970s and 1980s, the tourism grew rapidly, particularly as a result of growth in the ski resort industry in California and further development of gambling in Nevada near Lake Tahoe. This economic growth has led to additional real estate development in the area, particularly in the vacation-home market.

From 1980 to the present, economic trends in the river basin again have been dominated by growth in recreation, tourism, and gambling, as well as growth in the transportation/

warehouse sectors. At the same time, irrigated agriculture production in Truckee Meadows, as well as in the Newlands Project, has decreased.

6. Recreation

Settlers brought their cultural institutions and their need for services, including recreation, which expanded through time. From the time of John Fremont to the present, many factors have contributed to the enhancement and enjoyment of the recreation resources of the study area. The natural beauty of the high Sierra Nevada, with its alpine forests and natural fresh water lakes such as Lake Tahoe, Donner Lake, and Independence Lake, has attracted tourists for more than a hundred years. Construction of roads and railroads into the high country provided improved access, thereby increasing recreational opportunities. Construction of Prosser Creek, Stampede, Boca, and Lahontan Reservoirs to benefit farming/ranching indirectly benefited recreation by providing additional opportunities to picnic, swim, camp, hunt, and fish. Over time, the establishment of city, county, and State parks and private resort development, as well as the incorporation of land into the Federal estate, has enhanced recreation opportunities in the area.

a. Recreational Fishing

While in the Truckee River basin, Fremont benefited from the hospitality of the Paiute Indians by feeding on the “incredibly large” species of LCT, some weighing more than 40 pounds, which was plentiful in Pyramid Lake and the Truckee River (Nevada, 1997a). Although the fish were primarily a source of food for the Paiutes and early settlers and later as a commercial source for both, it can be assumed that because of their size and abundance, they also provided a recreational fishery. California’s efforts to maintain the LCT fishery in the Truckee River is well documented.

Settlement in the Truckee-Donner area began in the 1860s, based primarily on logging and railroad construction and operations. Silt loading from timber clearcutting and resultant hillside runoff degraded river water quality and affected native wildlife. It can be assumed that the quality of the recreational fishery declined as the quality of the Truckee River environment declined.

In 1875, because of depleted stocks of native fish in the Truckee River, the California Fish Commission released the first non-native fish species into the Truckee River upstream of the confluence of the Little Truckee River (Nevada, 1997a). The disappearance of LCT upstream of Verdi, Nevada, was recorded in 1880. The California Fish Commission filled the void with McCloud River rainbow trout, Eastern brook trout, and other non-native trout. In early 1880, a fisherman reported an occasional “keeper” (Townley, 1980).

After 1890, game fish were stocked in the Truckee River annually to meet the demands of sport fishing. Nevada’s restocking stressed the McCloud River trout and brook trout. Restocking was assisted by the Virginia & Gold Hill Water Company, which annually contributed over 250,000 fry from its Marlette Lake fish hatchery (Nevada, 1997a).

Between 1938 and 1944, the Pyramid Lake strain of LCT in Pyramid Lake was extirpated through a combination of physical impediment to upstream spawning runs, river pollution, sawdust covering spawning gravel, and overfishing (Nevada, 1997a).

Today, fishery management in the region is characterized by a proliferation of public/private/tribal partnerships. In recent years, voters have passed State and county bonds for the outdoors, including the Truckee River. Community-based planning and funding efforts have been focusing on developing the Truckee River within vegetated banks and wetlands rather than concrete and rock lined channels. Unneeded bridge abutments are being removed, old oxbows are being reclaimed, and trees are being planted. Within the river, boulders are being placed with the objective of restoring the river to a more wild condition, which will also provide better habitat for fish and opportunities for anglers. Restoration efforts could have the effect of returning the Truckee River to a first-class fishing river. The Pyramid Tribe has an extensive fishery program that includes partnerships with Nevada Department of Wildlife (NDOW) and FWS.

b. Tourism and Recreation

Tourism and recreation in the Sierra Nevada always has depended on access. Construction of the transcontinental Central Pacific Railroad in 1868 led to the founding of Truckee, California, and provided a gateway to Lake Tahoe and the surrounding area.

Lake Tahoe’s tourism expanded when the Bliss enterprise formed a new corporation, the Lake Tahoe Railway and Transportation Company, obtained a franchise, and in 1889 began construction on a narrow gauge railroad between Tahoe and Truckee. Service was offered three times a day during the summer, and the train and the climb were marvels. With the completion of the railroad, a 170-foot luxury excursion steamer, the Tahoe, was added in 1896. The Bliss corporation then built Tahoe Tavern, for many years a world famous hotel (Hinkle and Hinkle, 1987).

By the dawn of the 20th century, the extensive logging operations at Lake Tahoe had passed out in favor of an economy based on tourism and recreation. In 1931, gaming became legal in Nevada and a new industry was born.

In 1960, Lake Tahoe was given greater visibility when the Winter Olympics were held at Squaw Valley. The Winter Olympics elevated the importance of winter sports in the area to an international level, thus guaranteeing a steady stream of tourists.

Construction of dams and reservoirs between 1929 and 1970 and the subsequent development of associated facilities over time supplemented the recreation opportunities already existing at the many natural lakes in the study area. Demand for recreation in the Truckee area spawned the creation of the Truckee Donner Recreation and Parks District in 1962. Several of the recreation facilities adjacent to Donner Lake are managed by the District in cooperation with California State Parks. Most of the other recreation facilities associated with lakes and reservoirs are managed by USFS cooperating with many other governmental and private entities.

The Truckee River was not embraced by nearby residents, municipalities, and county governments as a recreational resource for the region until the 1970s and 80s. Since that time, a recreational river corridor was conceived, improvements to the river corridor have been made, and many recreational enhancements such as access facilities have been built (Resource Concepts, Inc., 2002).

The January 1997 flood provides an indication of a newly developed respect of the Truckee River as a recreational amenity. COE proposed rebuilding the flood walls that lined the Truckee River, but a task force of residents convened by local governments persuaded COE to rethink past flood control measures. With a sales tax to fund the community's share of the project, the task force developed a plan that would return the river to a more natural state and provide flood protection while enhancing river based recreation (Reno Gazette Journal, 2003). The future of river recreation on the Truckee River can be characterized as being based on private public partnerships and support for restoration, environmental enhancement, and recreational projects.

7. Cultural Resources

Human cultural resources are often transitory. Successive cultures that used similar resources often settled in and used the same locations as those they followed. The result is that remains of earlier settlements were displaced or destroyed, or the context of materials of a particular period lost. The more intensive the settlement or use of the land, the greater the probability of loss of these earlier sites.

Reservoir construction inundated most sites and, in some cases, subjected shoreline sites to wave action, destroying any evidence or context. As transportation infrastructures and economic bases expanded, humans built many cities and towns over previous settlements. Such development and the subsequent increases in human land use can also contribute to site erosion or unauthorized collecting. Large-scale construction and ground disturbance activities associated with mining, logging, and ranching altered the natural environment and earlier sites. Some sites were more ephemeral than camps; many were located in areas of extensive timbering or grazing. Therefore, some sites may have been compromised due to extensive resource consumption by humans and animals alike.

GENERAL METHODS AND ASSUMPTIONS

This section provides an overview of the general methods and assumptions used to evaluate resources under current conditions, the No Action Alternative (No Action), Local Water Supply Alternative (LWSA), and Truckee River Operating Agreement Alternative (TROA). Additional methods of analysis are presented for indicators of each resource.

I. COMPARATIVE EVALUATION OF ALTERNATIVES

In compliance with the National Environmental Policy Act (NEPA), this revised DEIS/EIR compares the potential effects (beneficial and adverse) of the two action alternatives (LWSA and TROA) on resources in the study area to No Action. Under NEPA, mitigation is not required for any adverse effects that may occur under No Action. Mitigation may be necessary for adverse effects under the action alternatives.

Additionally, in compliance with the California Environmental Quality Act (CEQA), this document compares the potential effects on resources under the alternatives (No Action, LWSA, and TROA) to the existing environmental setting, or "current conditions," as used in this document. As under NEPA, mitigation is not required for any adverse effects that may occur under No Action; however, CEQA Guidelines (section 15126.4(a)) require the document to discuss feasible measures to avoid or substantially reduce a project's significant environmental effects.

Thus, in this document, the effects of No Action are compared to current conditions, and the effects of the action alternatives are compared both to current conditions and to No Action.

Because resources in the study area are numerous and complex, some resources were analyzed using representative indicators. For example, rather than analyzing all fish populations, certain species were selected to provide a focused analysis of the effects of the alternatives. The analyses that used resource indicators are considered adequate to address all potentially significant effects on that resource.

II. USE OF THE TRUCKEE RIVER OPERATIONS MODEL

A computer model, the Truckee River Operations Model (operations model), was used to help analyze current conditions and the alternatives. "Water Resources: Environmental Consequences, Method and Operations Model Input Assumptions" identifies modeled operational elements of current conditions and the alternatives.

Computer models are commonly used to simulate water facility or resource operations for a hydrologic (e.g., river) system, particularly when a number of complex or competitive tasks must be performed. The results of model operations for different alternatives can be compared to identify and quantify potential effects on resources of interest.

Current conditions, No Action, and the two action alternatives identify river operations for managing available water resources to satisfy water demands (i.e., M&I, agriculture, water quality, hydroelectric power generation, aquatic and riparian habitat) at various points along the Truckee River. The capacity of each alternative to manage water resources and to satisfy demand is dependent on both amount and timing of the water supply and demand. If these supply and demand variables are known and held constant, the capacity of each alternative to achieve its objectives can easily be calculated through an accounting process.

A constant demand is simple to determine. A demand target could be based on projected use at a future time, which is the case for the three alternatives. Local planning agencies and water purveyors have developed a projected growth rate to guide resource management for the next several decades. (See table 3.3 in “Water Resources” for current annual consumptive water demands in the Truckee River basin in California and Nevada.) Based on population projections, TMWA’s M&I demand is projected to equal 119,000 acre-feet in the year 2033. Irrigation demand at that future time is then based upon the amount of agricultural water rights assumed to remain active once acquisitions and transfers to satisfy the M&I demands have been completed.

A steady state (constant) runoff pattern in the river basins is unrealistic to assume for comparing the three alternatives because precipitation and flow can vary widely, whether hourly, daily, weekly, monthly, seasonally, annually, or cyclically. This variability in hydrologic conditions is often represented by using historic data. Such hydrologic data are valuable because they illustrate what events are possible because they have occurred and have been recorded.

The longer the hydrologic data record, the greater the likelihood of representing the potential range of variability and frequency of occurrence in runoff at some future time (in this case, the year 2033). This analysis uses the 100-year (1901-2000) runoff record of monthly data for the Lake Tahoe, Truckee River, and Carson River basins as model input for current conditions and each alternative. Such a long (in human terms) record should promote confidence in evaluating proposals relative to variability of regional runoff and availability and use of water supplies.

Because use of the 100-year runoff data set requires a number of complex and repetitive accounting procedures, the operations model was used to simulate water management and use in the Truckee River and lower Carson River basins under current conditions and each alternative using a constant demand. It is the primary analytical tool used in this study. It is an accounting model that adds water inputs (i.e., runoff) to and subtracts water diversions and losses from the river basins on a monthly basis to calculate river flow and reservoir storage at specified locations. It tracks inflow to reservoirs; changes to reservoir storage according to operating criteria (“releases”); water reductions attributed to evaporation, spill, and diversions for agriculture and M&I use; and return flows.

The operations model yields a 100-year data set of simulated reservoir storage, releases, and spills; flows; and diversions and return flows for current conditions and each alternative. Because there is very little likelihood that the amount and timing of runoff from a given year would be repeated exactly in a future year, no individual year of simulated data should be considered representative of hydrologic conditions when the target demand is projected to occur (2033), but the probability of certain hydrologic conditions occurring can be calculated from the data set. The difference in each alternative's capacity to manage water and satisfy demand can be determined by comparing the probability sets associated with each alternative. These results can also be used to evaluate environmental impacts on water-dependent or water-related resources associated with changes in water management.

Elements of water management and facilities operation incorporated in the operations model are described in "Water Resources: Affected Environment, Water Management" and in "Water Resources: Environmental Consequences, Reservoir Storage and Releases." Such elements generally are referred to as "hard-wired" operations because they are conditioned on specific thresholds for storage, release, and diversion of water that are applied each month and year based upon various decrees, agreements, regulations, and criteria, as well as assumed voluntary actions by owners of water rights. In real time (i.e., actual operation), special conditions or extenuating circumstances could modify application of certain operations. For current conditions and No Action, the operations model incorporates operational elements that are being implemented today. For TROA, the operations model incorporates most operational elements that are provided for in the Draft Agreement as fully implemented, required water management facilities as operational, and all water rights identified for new beneficial uses as acquired, transferred, and exercised (i.e., in the year 2033). Examples of Credit Water operations are presented in the Water Resources Appendix. For LWSA, operational elements different from No Action are included to meet future water demand in the absence of TROA.

Data input to the operations model is discussed in "Water Resources: Environmental Consequences, Method and Operations Model Input Assumptions." Simulated hydrologic data generated by the operations model ("output") are presented as follows:

- Monthly storage and releases for Truckee River reservoirs.

- Average monthly flow at various points in the Truckee River and tributaries.

In addition to being expressed in monthly values, these data are also expressed in terms of probabilities of exceedence, defined as the likelihood that a value for a certain parameter would be equaled or exceeded during the period of analysis. Probabilities of exceedence are used to describe hydrologic conditions for reservoirs or stream locations. For example, storage associated with 90-percent exceedence would likely be relatively small because it would be equaled or exceeded 90 out of 100 times (90 percent) during the hydrologic period and would be considered "dry" hydrologic conditions. A 50-percent exceedence would represent a moderate amount of water because it would be equaled or exceeded 50 out of 100 times (50 percent), and would be considered "median" hydrologic conditions. A 10-percent exceedence would equate to wet hydrologic conditions.

In this study, "hydrologic condition" refers only to a specific reservoir storage or release or flow in a stream reach; it is not necessarily indicative of the magnitude of runoff or total water availability in the basin during a water year.

For most analyses, effects on resources were considered in three hydrologic conditions: wet, median, and dry. Some analyses also considered very wet (5-percent exceedence) or very dry (95-percent exceedence) hydrologic conditions, depending on the resource indicator. Additionally, flows for certain ***representative wet, median, and dry water years*** were analyzed for some indicators of water quality. (See the Water Quality Appendix.)

III. STUDY ASSUMPTIONS

In addition to operations, this study is based on numerous assumptions about population level, water demands, period of analysis, and water right transfers; these are described in the following sections. (See "Water Resources" for further discussion of assumptions for water supply and demand used in the operations model.)

A. Population Level and Water Demands

Projections of future demand (2033) on the water supply depend on several factors. The key factor is the larger future urban populations and the related transfer of water rights from irrigated agriculture to M&I use.

Future population, per capita use rate, and water demand were projected by the entities responsible for planning for M&I water use and supply in the Lake Tahoe and Truckee River basins. For Truckee Meadows, these entities are Washoe County and TMWA. For the California and other Nevada portions of the basin, these entities are California Department of Finance, California Department of Water Resources (CDWR), Tahoe Regional Planning Agency (TRPA), Nevada Division of Water Resources (NDWR), city of Fernley, and the Pyramid Tribe.

Population growth was projected to be the same in Truckee Meadows under No Action, LWSA, and TROA. Water demand in Truckee Meadows was also projected to be the same under No Action, LWSA, and TROA; however, sources of water or mechanisms to provide water might differ among the alternatives. (See chapter 2.)

It was assumed that increased M&I demand on the Truckee River under the alternatives would result in additional transfer of water rights from agriculture to M&I use. TMWA's projections of the amount of water rights to be purchased to serve growing M&I demand and the resulting reduction in agriculture were also considered.

The city of Fernley currently is supplied by groundwater sources; all new residential developments are required to provide surface water rights to serve new customers. This trend is expected to continue in the future. The water rights are being purchased from the Truckee Division of the Newlands Project. Fernley is actively pursuing transfer of ownership, purpose, place, and use of these water rights. Population growth and per capita use rates were provided by Fernley and used to establish future water demand.

The descriptions of the alternatives in chapter 2 include projections of surface water and groundwater usage and water conservation. The Economics Appendix contains detailed information and discussion of population projections. The Water Resources Appendix addresses future water demand and transfer of ownership, purpose, place, and use of water rights.

B. Period of Analysis

Consistent with provisions of the Draft Agreement, this revised DEIS/EIR assumes that TROA would be fully implemented when TMWA's normal water supply for its wholesale and retail service area is equal to 119,000 acre-feet per year. Water planning documents project this condition to occur in the year 2033. If growth rates are higher or lower, TMWA will reach its full use of water earlier or later, respectively, than projected.

C. Water Rights Transfers

In order to implement TROA, the following actions would require approval under applicable State law:

- The retention in storage of the consumptive use portion of all or a portion of the water that the signatories to TROA were entitled to divert from the Truckee River out of Floriston Rate releases, consistent with water rights and storage contracts.

- The reduction in releases for Floriston Rates to reflect such storage in lieu of diversions.

- All water right transfers to change the place or type of use of such storage.

- Pyramid Tribe obtaining the right to an ability to store Nevada unappropriated water of the Truckee River.

- Under WQSA, the transfer of water rights acquired to meet water quality goals in the Nevada portion of the lower Truckee River. (As of March 31, 2003, 3,133 acre-feet of water rights had been purchased, primarily from the Truckee Division of the Newlands Project.)

WATER RESOURCES

I. AFFECTED ENVIRONMENT

This section describes **current conditions** for water supply, demand, management, and operations. (See “Groundwater” for a more detailed description and analysis of that resource.) Water categories used in this section are defined in chapter 2, table 2.2.

A. Supply

Water supply in the Lake Tahoe and Truckee River basins consists of surface water and groundwater. Because supply depends on precipitation, total supply varies annually.

1. Surface Water

Surface runoff of precipitation is the primary source of water supply in the Truckee and Carson River basins. Most of the available Truckee River water supply is generated upstream of the USGS stream gauge at Farad, California. For this analysis, Carson River supply is measured at the USGS stream gauge near Fort Churchill, Nevada. Most of the Truckee and Carson River supply is produced during the spring runoff season (April to July) as the snow pack in the Sierra Nevada melts. As discussed previously, the climate of the Truckee and Carson River basins is characterized by cycles of flood and drought, and precipitation and runoff vary widely from year to year.

Historic annual discharge of the Truckee River at Farad ranges from a high of 1,768,980 acre-feet in 1983 to a low of 133,460 acre-feet in 1931. Average annual discharge at Farad is 561,800 acre-feet. Figure 3.1 shows annual historic discharge at Farad from 1900-2000.

Annual recorded discharge of the Carson River near Fort Churchill ranges from a high of 804,600 acre-feet in 1983 to a low of 26,260 acre-feet in 1977. Average annual discharge at Fort Churchill is 276,000 acre-feet. Figure 3.2 shows the annual historic discharge at Fort Churchill from 1910-2000.

a. Lake Tahoe Basin

The Upper Truckee River originates in the Sierra Nevada in northeastern California and discharges to the southern end of Lake Tahoe. Numerous other creeks and streams also flow directly into Lake Tahoe. The drainage area upstream of Lake Tahoe Dam is 506 square miles, of which the lake occupies 192 square miles. Average annual net inflow to Lake Tahoe is 180,400 acre-feet.

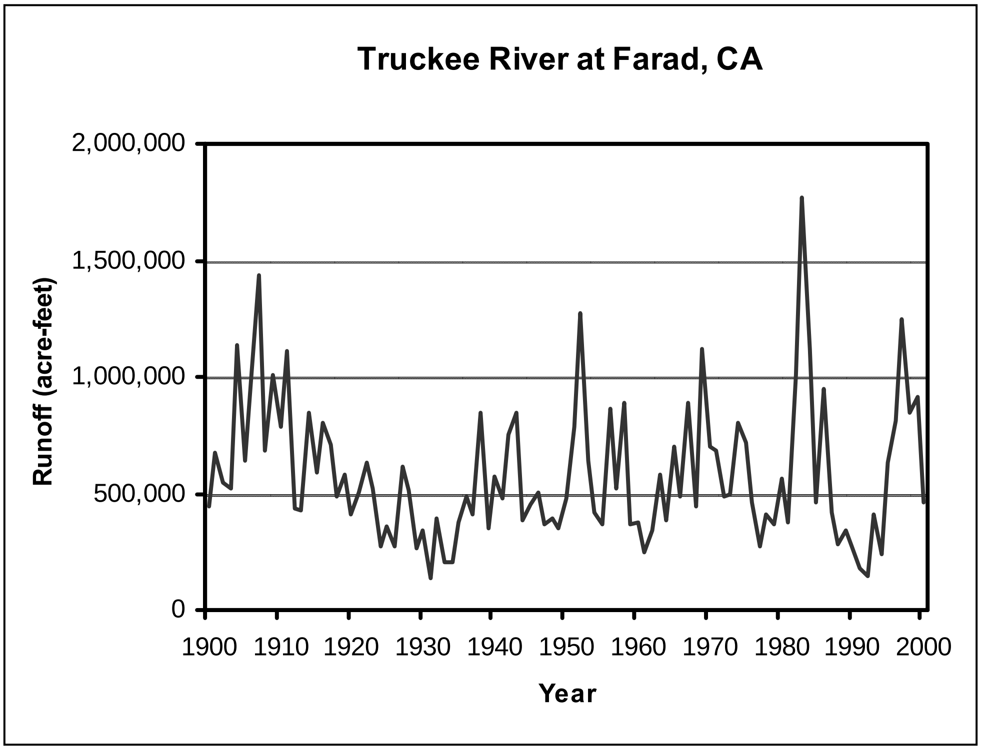


Figure 3.1.—Annual discharge at Farad, California, from 1900–2000.

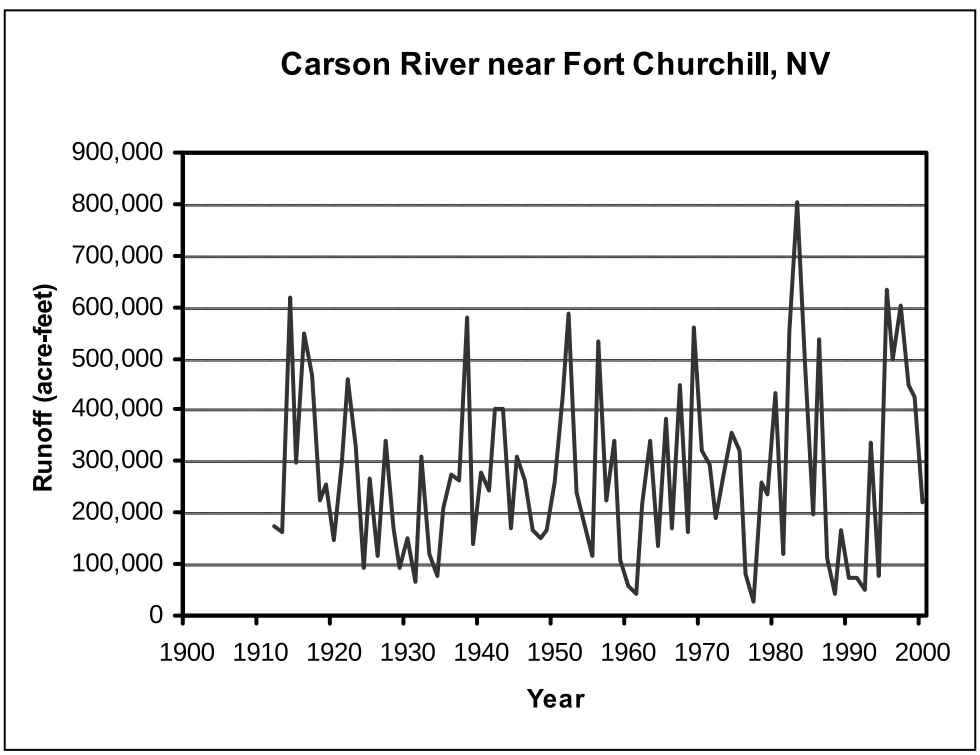


Figure 3.2.—Annual discharge near Fort Churchill, Nevada, from 1910–2000.

Lake Tahoe outflow is controlled by Lake Tahoe Dam, located near Tahoe City, California, at the natural outlet to the Truckee River. The natural outlet is at elevation 6223 feet and the dam is operated, to the extent practicable, to prevent lake elevation from exceeding 6229.1 feet. The dam creates 744,600 acre-feet of useable storage between elevation 6223 and 6229.1 feet.

b. Truckee River and Major Tributaries

From Lake Tahoe, the Truckee River flows generally north and east through California for about 40 miles and enters Nevada near Farad. The drainage area upstream of Farad is 933 square miles. The main tributaries are Donner, Martis, and Prosser Creeks and the Little Truckee River, all of which are regulated by dams. The unregulated drainage area covers 760 square miles and produces 30 percent of the average annual runoff at Farad.

Donner Creek drains an area of 30 square miles, enters the Truckee River about 14 miles downstream of Lake Tahoe Dam, and contributes 29,000 acre-feet of runoff annually. Martis Creek and Prosser Creek join the Truckee River about 7 miles downstream from Donner Creek, with drainage areas of 20 and 50 square miles, respectively. Martis Creek annual runoff averages 18,800 acre-feet and Prosser Creek 64,500 acre-feet.

Little Truckee River is the largest tributary to the Truckee River, with a drainage area of 173 square miles. It enters the Truckee River about 4 miles upstream of Farad. Tributaries are Independence, Sagehen, and Davies Creeks. Average annual runoff is 132,500 acre-feet.

Downstream from Farad, principal tributaries are Dog Creek and Hunter Creek, which have an average annual runoff of 4,500 and 7,000 acre-feet, respectively.

Within Truckee Meadows, Steamboat Creek drains an area of 130 square miles and contributes about 15,500 acre-feet annually to the Truckee River. Tributaries to Steamboat Creek are Galena, Evans, Thomas, and Whites Creeks. The 600-square-mile drainage area downstream from Truckee Meadows to Pyramid Lake provides only minimal contributions to the Truckee River water supply.

Table 3.1 presents the historic minimum, average, and maximum annual runoff at key locations in the Truckee River basin.

c. Reservoirs in the Truckee River Basin

Approximately 30 percent of the surface water supply upstream of Farad is regulated by Lake Tahoe and 40 percent by other Federal and non-Federal reservoirs located in California. In general, the reservoirs store Truckee River surface water in the spring and release it in the summer and early fall, primarily to meet demands in Nevada. Reservoir storage, along with natural runoff, determine the water supply available to Nevada.

Donner Lake is located on Donner Creek, on the western edge of the town of Truckee, California. The top 12 feet of Donner Lake is regulated by a concrete dam constructed at the

Table 3.1.—Historic Truckee River annual runoff (acre-feet per year)

Location	Period of record	Minimum	Average	Maximum
Truckee River At Tahoe City, CA	1909-2000	109	170,500	832,700
Donner Creek at Donner Lake, CA	1929-2000	5,580	26,330	60,300
Martis Creek near Truckee, CA	1959-2000	4,990	19,700	53,930
Prosser Creek downstream from Prosser Dam, CA	1943-2000	17,690	64,000	154,900
Little Truckee River downstream from Boca Dam, CA	1939-2000	40,250	135,000	340,200
Truckee River at Farad, CA	1909-2000	133,500	561,800	1,769,000
Truckee River at Reno, NV	1907-2000	76,700	509,400	1,701,000
Steamboat Creek at Steamboat, NV	1962-2000	1,390	15,550	83,000
Truckee River at Vista, NV	1900-2000	114,600	603,800	2,017,000
Truckee River downstream from Derby Diversion Dam	1918-2000	4,450	304,000	1,760,000
Truckee River near Nixon, NV	1958-2000	17,500	425,100	1,889,000

natural outlet. The dam is operated to prevent the lake from exceeding elevation 5935.8 feet and provides a usable reservoir of about 9,500 acre-feet. The lake is lowered to elevation 5927.7 feet by November 15 each year, which reduces the storage to 2,890 acre-feet in order to meet dam safety requirements. Inflow can only be temporarily stored from November 15 through April 15 of the following year.

Martis Creek Reservoir is located on Martis Creek approximately 2 miles upstream of the confluence with the Truckee River. The reservoir has a capacity of 20,400 acre-feet, used for temporary storage of flood flows.

Prosser Creek Reservoir is located on Prosser Creek about 1.5 miles upstream of the Truckee River and has a capacity of 29,800 acre-feet. Between November 1 and April 10 of the following year, reservoir storage is lowered to 9,800 acre-feet to provide 20,000 acre-feet for flood control.

Independence Lake is located on Independence Creek. An earth fill dam controls the top 28 feet of the lake above the natural outlet, providing a usable reservoir of 17,500 acre-feet. Between November 15 and April 15, reservoir storage is lowered to 14,500 acre-feet for dam safety reasons.

Stampede Reservoir is located on the Little Truckee River about 8 miles upstream of the Truckee River and 3 miles upstream of Boca Reservoir. The reservoir, which has a storage capacity of 226,500 acre-feet, is required to reserve 22,000 acre-feet of storage between November 1 and April 10 for flood control.

Boca Reservoir is located on the Little Truckee River, near its confluence with the Truckee River, and has a capacity of 41,100 acre-feet. Flood control storage of 8,000 acre-feet is reserved from November 1 to April 10 of the following year.

Pyramid Lake is the terminus of the Truckee River and covers approximately 110,000 acres.

d. Truckee Canal/Lahontan Reservoir

Truckee River flow is diverted at Derby Diversion Dam through the Truckee Canal to Lahontan Reservoir to supplement the Carson River water supply to the Carson Division of the Newlands Project. A portion of Truckee Canal flow is diverted upstream of Lahontan Reservoir to supply the Truckee Division.

Lahontan Reservoir is located on the Carson River about 18 miles west of Fallon, Nevada, and impounds Carson River flow and a portion of the Truckee River water diverted to the Truckee Canal. The reservoir has a storage capacity of about 317,000 acre-feet (with flashboards) and drainage area of about 1,799 square miles. Carson River discharge to Lahontan Reservoir averages about 276,000 acre-feet at Fort Churchill, Nevada. The Carson River terminates in the Carson Sink, east of Fallon, Nevada. Table 3.2 presents the historic annual minimum, average, and maximum discharge at USGS stream gauges stations on the Truckee Canal and Carson River.

Table 3.2.—Historic annual Truckee Canal and Carson River annual discharge (acre-feet)

Stream gauge	Period of record	Minimum	Average	Maximum
Truckee Canal near Wadsworth, NV	1967-2000	30,985	161,500	287,500
Carson River near Fort Churchill, NV	1911-2000	26,260	276,000	804,600
Carson River downstream from Lahontan Reservoir	1967-2000	131,400	372,900	771,900

Source: USGS Water-Data Report NV00-1 and other USGS publications.

e. Return Flow

Surface water return flows from irrigation and M&I uses supply water for downstream users. Irrigation return flows normally vary from 25 to 50 percent of the total water applied to the lands. TTSA-treated effluent from North Lake Tahoe, Alpine Meadows, Squaw Valley, Donner, Truckee, and the Martis Creek area percolates to the Truckee River just upstream of Martis Creek. Truckee Meadows Wastewater Reclamation Facility (TMWRF) discharges treated effluent to Steamboat Creek, a tributary to the Truckee River. This facility is the largest point source for surface water returns to the river.

Groundwater comprises a portion of the M&I water supply in the study area. See "Groundwater."

B. Current Demands

Following are demands on the total water supply, both consumptive and nonconsumptive. Water categories are defined in chapter 2, table 2.2.

1. Consumptive Demands

Consumptive demands are those in which all or a portion of the water supply is consumed and not returned to the system. These demands include agricultural and M&I uses and exports outside the Truckee River basin.

a. Agriculture

Current average annual agricultural demand diverted from the Truckee River to support agriculture in the Truckee Meadows is 53,000 acre-feet; 25 to 50 percent of irrigation water returns to the river. Major diversions from the river include Highland, Last Chance, Orr, and Pioneer Ditches.

Downstream from Truckee Meadows, there are numerous other diversions from the river, including several on the Pyramid Lake Indian Reservation. The largest diversion in this portion of the river is to the Truckee Canal to support Newlands Project agriculture. Newlands Project demands include 18,520 acre-feet in the Truckee Division and 275,700 acre-feet in the Carson Division.

The Pyramid Tribe holds water rights with the highest priority date (December 8, 1859), referred to as Claim Nos. 1 and 2 of the *Orr Ditch* Decree. Under Claim No. 1, the Pyramid Tribe has the right to divert irrigation water in an amount not to exceed 4.71 acre-feet per acre for 3,130 acres of bottom land (14,742 acre-feet per year). Claim No. 2 gives the right to divert another 5.59 acre-feet per acre for 2,745 acres of bench land (15,345 acre-feet per year).

b. M&I

Truckee Meadows M&I demand is 83,140 acre-feet, of which 29,710 acre-feet return to the river. Most of this demand is met with surface water supplies. TMWA holds a right for a continuous flow of 40 cfs (28,959 acre-feet per year) for M&I use with a priority junior only to Claim Nos. 1 and 2, as defined in the Truckee River Agreement and incorporated in the *Orr Ditch* Decree. In addition, TMWA holds 9,878 acre feet of Hunter Creek rights and normally pumps about 14,820 acre-feet per year of groundwater and 22,000 acre-feet per year in drought situations. As of 2002, TMWA held title to or had leased 57,170 acre-feet of agricultural water rights for M&I use.

Additional M&I water supply demands in Nevada include 9,379 acre-feet in the Lake Tahoe basin, which are met by surface water supplies. M&I demands of 1,120 acre-feet on the Pyramid Lake Indian Reservation and 3,280 acre-feet in the city of Fernley currently are met by groundwater supplies.

State of Nevada Permit Nos. 48061 and 48494 allocate the remaining unappropriated waters of the Truckee River for Pyramid Lake. Currently this is under appeal. If upheld, the Truckee River and its tributaries in Nevada would be fully appropriated.

In California, total M&I demand is approximately 27,300 acre-feet per year: about 18,700 acre-feet in the Lake Tahoe basin and 8,600 acre-feet in the Truckee River basin. In the Truckee River basin, surface water supplies meet about 1,000 acre-feet of the demand, and groundwater supplies meet about 7,600 acre-feet. Some of the water supply is exported out of the Truckee River basin, as shown in table 3.3, which also summarizes current consumptive demands, including M&I and agriculture, in California and Nevada.

Table 3.3.—Current (2002) annual consumptive demands in the Lake Tahoe and Truckee River basins (acre-feet)

M&I demand in California	
Lake Tahoe basin	18,700
Truckee River basin	8,570
M&I demand in Nevada	
Lake Tahoe basin	9,379
Truckee Meadows (TMWA)	83,140
Washoe County	9,900
Tracy hydroelectric plant	1,950
Pyramid Tribe	1,120
Fernley	3,280
Agricultural demand in California	
Truckee River basin	1,800
Agricultural demand in Nevada	
Truckee Meadows	40,770
Newlands Project	
Truckee Division	18,520
Carson Division	275,700
Lower Truckee River	12,040
Out-of-basin exports in California	
To Sierra Valley	7,000
To South Fork of American River	2,000
To Carson River	4,800
Out-of-basin exports in Nevada	
To Carson River[1]	5,000
To Stead (supplied by TMWA)	1,680

[1] Sewage effluent from South Tahoe Public Utility District.

2. Nonconsumptive Demands

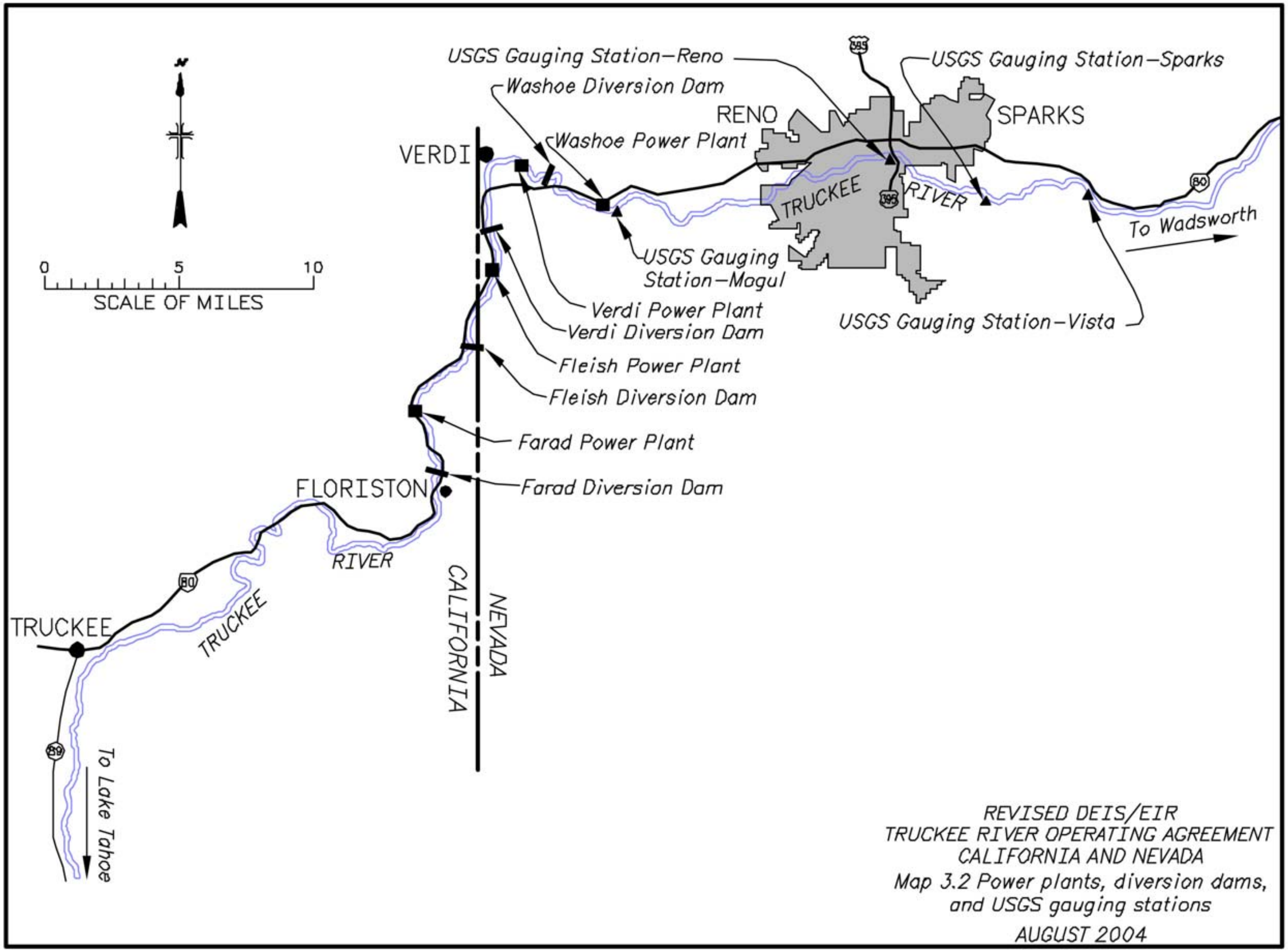
Nonconsumptive demands are those in which the water supply provides beneficial uses but is not diminished in quantity for downstream users. In the Truckee River basin, these demands primarily include hydroelectric power generation, flows to provide and maintain fish habitat (table 3.4), and reservoir storage for recreation.

Table 3.4.—Current (2002) nonconsumptive water demands (cfs) in the Lake Tahoe and Truckee River basins

Hydropower (maximum diversion right) in California	
Farad	400
Hydropower (maximum diversion right) in Nevada	
Fleish	327
Verdi	399
Washoe	396
Minimum releases in California	
Lake Tahoe	
October-March	50
April-September	70
Donner Lake	2-3
Prosser Creek Reservoir	5 (or minimum flow if less than 5 cfs)
Independence Lake	2
Stampede Reservoir	30
Boca Reservoir	0
Farad hydroelectric plant bypass	150
Minimum releases in Nevada	
Fleish hydroelectric plant bypass	50
Verdi hydroelectric plant bypass	50
Washoe hydroelectric plant bypass	50

a. Hydropower Generation

Four run-of-the-river hydroelectric plants are located along the Truckee River between the Little Truckee River and Reno: Farad, Fleish, Verdi, and Washoe (map 3.2). To generate power, water is diverted to wooden flumes that flow to the riverside plants, where it passes through penstocks and rotating turbines or through bypass spillways, and then returns to the river. Historically, stretches of the river between the diversion structure and the point of return were frequently dry during portions of the year. Sierra Pacific has agreed to maintain a minimum bypass flow of 50 cfs at each of the four hydroelectric plant diversion dams; in addition, as a condition of rebuilding the Farad diversion dam, SWRCB will require Sierra Pacific to maintain at the Farad diversion dam a 150 cfs minimum bypass, or the total Truckee River flow immediately upstream of the diversion dam, if less than 150 cfs.



REVISED DEIS/EIR
TRUCKEE RIVER OPERATING AGREEMENT
CALIFORNIA AND NEVADA
Map 3.2 Power plants, diversion dams, and USGS gauging stations
AUGUST 2004

Two hydroelectric plants at Stampede Dam have a combined capacity of 3.65 megawatts and a combined delivery rate of 300 cfs. Two hydroelectric plants at Lahontan Dam, with a capacity of 1.92 megawatts and delivery rate of 750 cfs, can receive water from the Truckee Canal or Lahontan Reservoir. These hydroelectric plants do not have water rights and are only operated when releases are made to meet other downstream demands.

b. Minimum Reservoir Releases

A minimum release of 30 cfs is maintained from Stampede Reservoir under an informal agreement between BOR and California Department of Fish and Game (CDFG).
Table 3.4 lists current minimum flows by location.

c. Recreation Storage

In the Truckee River basin, recreational interests are generally served incidental to water rights.

C. Current Water Management

Numerous laws, court decrees, and agreements govern the current operation of reservoirs in the Truckee and Carson River basins. Some of the key operating constraints on the Truckee River are the *Truckee River General Electric* Decree; Truckee River Agreement; *Orr Ditch* Decree; and Tahoe-Prosser Exchange Agreement. The *Alpine* Decree governs the exercise of water rights in the Carson River basin, and OCAP regulates operations on the Newlands Project.

1. Truckee River General Electric Decree

The *Truckee River General Electric* Decree set forth the operating constraints for Lake Tahoe, granted BOR the right to use Lake Tahoe dam to regulate streamflows for the Newlands Project, and established the original Floriston Rates (later modified by TRA). Floriston Rates provided a minimum flow in the river of 500 cfs from March through September and 400 cfs the remainder of the year, as long as water was available in Lake Tahoe. Floriston Rates were intended to provide sufficient streamflow for a pulp and paper mill near Floriston, California, and the four run-of-the-river hydroelectric plants. (At the time of the *Truckee River General Electric* Decree, Floriston Rates were measured at the Iceland, California, stream gauge.)

2. Orr Ditch Decree

The 1944 *Orr Ditch* Decree, entered by the U.S. District Court for the District of Nevada in the quiet title action, *United States* v. *Orr Water Ditch Co., et al.*, No. A-3 in Equity, adjudicated water rights of the Truckee River in Nevada and established amounts, places and types of use, and relative priorities of the various rights. The decree incorporated the 1935 Truckee River Agreement as binding among Sierra Pacific Power Company (Sierra Pacific), TCID, WCWCD, U.S. Department of the Interior (Interior), and certain other Truckee River water users ("parties of the fifth part") providing for, among other things, reduced Floriston Rates, and for the construction of what is now Boca Reservoir. The *Orr Ditch* Decree, along with the 1915 *Truckee River General Electric* Decree, discussed previously, and the Tahoe-Prosser Exchange Agreement, discussed in the following paragraph, provides the current operational framework and rules for Truckee River reservoirs. The provisions of the *Orr Ditch* Decree are administered by the Federal Water Master appointed by the *Orr Ditch* court.

3. Tahoe-Prosser Exchange Agreement

TPEA supplements TRA with additional criteria for operations of Lake Tahoe and Prosser Reservoir. TPEA allows streamflow maintenance releases to be made from Lake Tahoe when releases are unnecessary to meet Floriston Rates. Minimum releases of 70 cfs from April through September and 50 cfs the remainder of the year are made when an equivalent amount of water in excess of Prosser Creek minimum releases of 5 cfs is available for storage. If inflow to Prosser Creek is less than these releases, and there is no storage available, releases from Lake Tahoe are reduced to that of Prosser Creek inflow.

4. Alpine Decree

The *Alpine* Decree is the 1980 adjudication of the Carson River water rights and priorities in California and Nevada. Under the decree, waters of the Carson River are fully appropriated.

5. OCAP

OCAP establishes procedures to define the annual water demand of the Newlands Project and regulates the diversion of water from the Truckee River to meet that demand. OCAP includes provisions for a maximum annual diversion, implementation of conservation measures to improve project efficiency, and criteria for diverting Truckee River water to the Newlands Project for agricultural use and storage in Lahontan Reservoir.

6. Carson-Truckee Water Conservancy District v. Watt, 1982

Federal court ruled that the Secretary shall use storage in Stampede Reservoir for the conservation of Pyramid Lake fishes because ESA took precedence over any obligation to contract for delivery of water for irrigation and M&I uses. This ruling guides current operations of Stampede Reservoir.

7. Interim Storage Agreement

This 1994 agreement among Interior, Sierra Pacific, WCWCD, and the Pyramid Tribe allows Sierra Pacific to store privately owned water from Independence Lake and Donner Lake in Stampede and Boca Reservoirs; this water would be used to meet domestic and M&I water needs in Truckee Meadows during drought situations. Up to 14,000 acre-feet of privately owned water can be stored; however, any privately owned water in excess of 5,000 acre-feet is converted to Fish Water on September 1 of each year.

8. Truckee River Water Quality Settlement Agreement

WQSA (1996) established a program to improve Truckee River water quality through the purchase and transfer of Truckee River water rights for the purpose of maintaining streamflow. Water associated with WQSA water rights could be stored in Stampede and Prosser Creek reservoirs and managed by the WQSA parties for water quality and aesthetic purposes.

D. Current Operations

This section describes current operations of Truckee River reservoirs for flood control, dam safety, minimum releases, storage, and streamflow. These operations were modeled for this study. See “Method and Operations Model Input Assumptions” in the Environmental Consequences section for a discussion of modeled demands under current conditions and the alternatives.

The Federal Water Master in Reno is responsible for coordinating operation of the Truckee River reservoirs to:

- Regulate releases in coordination with BOR and COE in accordance with flood control and dam safety requirements.

- Maintain minimum releases.

- Store and release water to satisfy exercise of *Orr Ditch* Decree water rights.

1. Flood Control

Martis Creek Reservoir is operated only for flood control purposes. Temporary storage space is required by COE in several of the reservoirs as follows:

- Prosser Creek Reservoir - 20,000 acre-feet by November 1
- Stampede Reservoir - 22,000 acre-feet by November 1
- Boca Reservoir - 8,000 acre-feet by November 1

Stored water may be required to be released to achieve these criteria.

Lake Tahoe is operated to limit high-water damage to lakeshore property, and releases to the Truckee River are made to ensure that the lake does not exceed elevation 6229.1 feet.

Flood waters are stored temporarily in Prosser Creek, Stampede, Boca, and Martis Creek Reservoirs when Truckee River flow at Reno is 6,000 cfs or higher. Even with no releases being made from reservoirs during a flood event, unregulated runoff can exceed that amount.

2. Dam Safety Requirements

To meet dam safety requirements, storage in Donner Lake and Independence Lake is lowered to 3,000 acre-feet and 15,200 acre-feet, respectively, by November 1.

3. Minimum and Bypass Flow Requirements

Minimum reservoir releases and hydroelectric plant bypass flows are shown in table 3.4. Lake Tahoe minimum releases are subject to the availability of water in Prosser Creek Reservoir to exchange.

4. Floriston Rates

Floriston Rates are met by unregulated flow and releases from Project Water stored at Lake Tahoe and Boca Reservoir. Tahoe-Prosser Exchange Water is also released to meet Floriston Rates, primarily late in the irrigation season.

Releases are made from Tahoe-Prosser Exchange Water stored in Prosser Creek and Project Water stored in Lake Tahoe and Boca Reservoir to meet all or a portion of Floriston Rates when unregulated follow is insufficient to meet Floriston Rates. The releases are generally made in the following order:

April through October:

First, Project Water stored in Lake Tahoe when the lake is below elevation 6225.5 feet to ensure that the greatest amount of Project Water can be released in anticipation of the reservoir potentially falling below the natural outlet and being unavailable until the reservoir rises above the natural outlet.

Second, Project Water stored in Boca Reservoir. The order is reversed when Lake Tahoe is above elevation 6225.5 feet, with releases being made first from Boca Reservoir and secondly from Lake Tahoe. The Federal Water Master may vary this slightly to help maintain relatively consistent flow in the river downstream from Lake Tahoe.

Third, Tahoe-Prosser Exchange Water stored in Prosser Creek Reservoir. Tahoe-Prosser Exchange Water tends to be released to meet Floriston Rates later in the season from June through October. Because storage of Tahoe-Prosser Exchange Water may not interfere with flood control requirements, the Federal Water Master strives to release all Tahoe-Prosser Exchange Water before November 1.

November through March:

Boca Reservoir is generally the source of water for Floriston Rates, although Lake Tahoe frequently is a major contributor.

Floriston Rates cannot be met at all times by unregulated flow and Project Water releases from Lake Tahoe and Prosser Creek and Boca Reservoirs. When this occurs, priorities for use of the available water are subject to the *Orr Ditch* Decree.

5. Storing Water in Reservoirs

Donner and Independence Lakes can store water adverse to Floriston Rates. Donner Lake may store up to 9,500 acre-feet of Donner Creek inflow after April 15 of each year. Independence Lake has a right to store the first 3,000 acre-feet of Independence Creek inflow each year.

Water cannot be stored in Lake Tahoe or in Prosser Creek, Stampede, or Boca Reservoirs until Floriston Rates are met. When unregulated flow is great enough so that Floriston Rates requirements are exceeded, Lake Tahoe has the first right to store Project Water. If Floriston Rates are still exceeded, up to 25,000 acre-feet of Project Water may be stored in Boca Reservoir.

Beyond these conditions, another condition must be met for Truckee River water to be stored: there must be sufficient water to meet Truckee Canal diversion requirements for irrigation of the Newlands Project subject to OCAP.

An additional 15,850 acre-feet may now be stored to fill Boca Reservoir. After Boca Reservoir fills, Independence Lake has the right to store an additional 14,500 acre-feet of Independence Creek inflow, if available.

Stampede Reservoir has the next right to store up to 126,000 acre-feet, followed by Prosser Creek Reservoir, with a right to store up to 20,000 acre-feet of Project Water. Project Water stored in Prosser Creek Reservoir not needed for the Tahoe-Prosser Exchange and Project Water stored in Stampede Reservoir is used to meet Pyramid Lake fishes flow requirements. Prosser Creek Reservoir may store Tahoe-Prosser Exchange Water any time appropriate conditions exist. Tahoe-Prosser Exchange Water is used to meet Floriston Rates.

6. Truckee River Operations for Pyramid Lake Fishes

Project Water stored in Stampede and Prosser Creek Reservoirs for the benefit of Pyramid Lake fishes is currently managed using flow regime criteria developed by FWS based on six hydrologic year types and the amount of Stampede Project Water (and Fish Credit Water under TROA) in storage on March 1 (referred to as the six-flow regime in “Biological Resources.”) While the flow regime criteria consider the biological requirements of fish, it also incorporates ecosystem considerations, such as flows that enhance the establishment and maintenance of willow and cottonwoods. (See “Biological Resources” for a detailed discussion and analysis.) Table 3.5 presents hydrologic year types; table 3.6 presents Stampede Reservoir storage levels.

Table 3.5—Hydrologic year types

Stampede Reservoir March through July inflow (acre-feet)	Hydrologic year type
Greater than 150,000	Wet
Greater than 107,000 and less than 150,000	Above average
Greater than 76,000 and less than 107,000	Average
Greater than 52,000 and less than 76,000	Below average
Greater than 30,000 and less than 52,000	Dry
Less than 30,000	Critical

Table 3.6—Stampede Reservoir storage levels

Stampede Fish Water storage on March 1 (acre-feet)	Level
Greater than 200,000	Full
Greater than 150,000 and less than 200,000	High
Greater than 100,000 and less than 150,000	Low
Less than 100,000	Critical

Using the hydrologic year type and Stampede Reservoir storage, a flow regime is selected according to table 3.7.

Table 3.7.—Flow regime selection

Storage level	Hydrologic year type					
	Wet	Above average	Average	Below average	Dry	Critical
Full	1	1	1	1	3	4
High	1	1	2	2	4	5
Low	1	1	3	4	6	6
Critical	2	3	5	6	6	6

Each flow regime has a set of monthly inflow targets to Pyramid Lake. An appropriate regime is selected as the forecast is updated each month through July. A single flow regime is selected for operations from August through the following February. Table 3.8 presents the monthly inflow targets for each flow regime.

Table 3.8.—Pyramid Lake inflow targets (cfs) for flow regime Nos. 1-6

Month	1	2	3	4	5	6
January	160	150	120	110	100	90
February	160	150	120	110	100	90
March	290	220	200	160	160	140
April	590	490	420	350	300	200
May	1,000	800	600	530	400	300
June	800	600	500	400	270	170
July	300	300	300	200	150	120
August	200	200	200	200	150	110
September	170	170	120	110	100	100
October	160	150	120	110	100	100
November	160	150	120	110	100	90
December	160	150	120	110	100	90

These inflow targets are modified in years with substantial spring runoff. In years when the May and June inflow to Pyramid Lake exceeds 1,000 cfs, the August and September inflow targets are set to 300 cfs.

When unregulated lower Truckee River flow is below the inflow target, Fish Water is released from Prosser Creek and/or Stampede Reservoirs.

See chapter 2 for discussions of operations under No Action, LWSA, and TROA.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

Modifying operations of Truckee River reservoirs could affect reservoir storage and releases and the quality, quantity, timing, and duration of flows. This analysis evaluated the effects of changes in storage and flows using the following parameters:

1. Total amount of water in storage upstream of Farad and end-of-month storage and average monthly releases in wet, median, and dry hydrologic conditions for the following reservoirs:

   Lake Tahoe
   Donner Lake
   Prosser Creek Reservoir
   Independence Lake
   Stampede Reservoir
   Boca Reservoir
   Lahontan Reservoir

Effects on Pyramid Lake are evaluated as inflow, measured as flows at Nixon.

2. Average monthly Truckee River flow in wet, median, and dry hydrologic conditions for the following locations:

   Farad, California
   Vista, Nevada
   Nixon, Nevada

3. Exercise of water rights to meet the following demands in the minimum supply year:

   Agriculture
   - Truckee Meadows
   - Newlands Project
     - Truckee Division
     - Carson Division
   - Lower Truckee River

   M&I
   - Lake Tahoe basin
   - Truckee River basin in California
   - Truckee Meadows

B. Summary of Effects

The total amount of water in storage upstream of Farad is an indicator of the water supply in the Truckee River system to satisfy consumptive and nonconsumptive demands. Operations model results show that the total amount of water in storage is greater under TROA than under No Action, LWSA, or current conditions, primarily in Stampede, Boca, and Prosser Creek Reservoirs.

Each alternative includes release targets for environmental and recreational benefits. In dry hydrologic conditions, operations model results show that flows in Independence Creek, Little Truckee River, and Prosser Creek are appreciably greater under TROA than the other alternatives because of higher minimum flow releases and the ability to exchange Credit Water among the reservoirs. In addition, in dry hydrologic conditions, Truckee River flows through and downstream from Truckee Meadows are greater under all alternatives than under current conditions because of the releases of Water Quality Water.

Carson Division demands are met in wet, median, and dry hydrologic conditions. Lower Truckee River agricultural and M&I water rights are met under all alternatives.

California's current M&I demand is satisfied under current conditions, and its future M&I demand is satisfied under the alternatives. Truckee Meadows M&I demands are met under current conditions. Operations model results show that in the minimum supply year, M&I supply is greater under TROA than under No Action or LWSA. Tables 3.9a, 3.9b, and 3.10 summarize the effects on water resources.

Table 3.9a.—Summary of effects on reservoir storage and releases

Location	No Action	LWSA	TROA
Total water in reservoirs upstream of Farad	Slightly less than under current conditions	Same as under No Action.	Much greater than under No Action and current conditions.
Lake Tahoe	Slightly less storage and same releases as under current conditions.	Same storage and releases as under No Action.	Similar storage and much higher May-June releases than under No Action and current conditions.
Donner Lake	Same storage and releases as under current conditions.	Same storage and releases as under No Action.	Similar storage as under No Action and much higher September–October releases than under No Action.
Prosser Creek Reservoir	Wet hydrologic conditions: same storage and releases as under current conditions. Median hydrologic conditions: greater July–September storage; lower May–June releases; much higher October releases than under current conditions. Dry hydrologic conditions: much greater January–December storage; lower May–June releases; much higher October releases than under current conditions.	Same as under No Action in all three hydrologic conditions.	Wet hydrologic conditions: same storage and releases as under No Action. Median hydrologic conditions: greater April–September storage; lower May–June releases; much higher September–October releases than under than under No Action and current conditions. Dry hydrologic conditions: much greater January–December storage; lower May–June releases; much higher September–October releases than under No Action and current conditions.

Table 3.9a.—Summary of effects on reservoir storage and releases

Location	No Action	LWSA	TROA
Independence Lake	Same storage and releases as under current conditions.	Same storage and releases as under No Action.	Wet and median hydrologic conditions: same storage and releases as under No Action. Dry hydrologic conditions: greater July–September storage; less November–June storage; higher May–September releases than under No Action and current conditions.
Stampede Reservoir	Wet hydrologic conditions: greater August–September storage and same releases as under current conditions. Median hydrologic conditions: Less January–December storage and same releases as under current conditions. Dry hydrologic conditions: greater Jan-Dec storage and higher March and July releases than under current conditions.	Same storage and releases as under No Action.	Wet hydrologic conditions: greater May–September storage and higher September–December releases than under No Action and current conditions. Median hydrologic conditions: much greater January–December storage; lower November–August releases; much higher October releases than under No Action and current conditions. Dry hydrologic conditions: much greater January–December storage and releases than under No Action and current conditions.
Boca Reservoir	Same storage and releases as under current conditions.	Same storage and releases as under No Action.	Wet hydrologic conditions: less August and greater October–December storage than under No Action. Median hydrologic conditions: greater August–March storage than under No Action. Dry hydrologic conditions: greater January–December storage than under No Action.

Table 3.9a.—Summary of effects on reservoir storage and releases

Location	No Action	LWSA	TROA
Pyramid Lake	Ending elevation and inflow lower than under current conditions.	Ending elevation and inflow lower than under No Action and current conditions.	Ending elevation and inflow higher than under No Action and current conditions.
Lahontan Reservoir	Wet hydrologic conditions: slightly greater September–February storage; same releases as under current conditions. Median and dry hydrologic conditions: less January–December storage; lower April–September releases than under current conditions.	Same as under No Action.	Same as under No Action.

Table 3.9b.—Summary of effects on Truckee River flow

Location	No Action	LWSA	TROA
Farad	Slightly lower than under current conditions.	Same as under No Action.	Wet hydrologic conditions: higher December–June and August–September flows than under No Action and current conditions. Median hydrologic conditions: lower June–January flows and higher March–May flows than under No Action and current conditions. Dry conditions: lower December–July flows and higher September–October flows than under No Action and current conditions.

Table 3.9b.—Summary of effects on Truckee River flow

Location	No Action	LWSA	TROA
Vista	Slightly lower than under current conditions.	Same as under No Action.	Wet hydrologic conditions: slightly higher January–May flows than under No Action and current conditions. Median hydrologic conditions: higher April–October flows and lower November–March flows than under No Action and current conditions. Dry hydrologic conditions: lower November–June flows and higher July–October flows than under No Action and current conditions.
Nixon	Wet and median hydrologic conditions: same as under current conditions. Dry hydrologic conditions: higher August–February flows than under current conditions.	Same as under No Action.	Wet hydrologic conditions: slightly higher December–July flows than under No Action and current conditions. Median hydrologic conditions: higher April–October flows and lower November–March flows than under No Action and current conditions. Dry hydrologic conditions: higher August–February flows than under No Action and current conditions.

Table 3.10.—Summary of effects on exercise of water rights to meet demands

Type	No Action	LWSA	TROA
Agricultural	Truckee Meadows: much less demand and a greater percentage of demand met in minimum supply year than under current conditions.	Truckee Meadows: same demand as under No Action and a greater percentage of demand met in minimum supply year than under current conditions.	Truckee Meadows: much less demand than under No Action and current conditions and greater percentage of demand met in minimum supply year than under No Action and current conditions.
	Newlands Project: much less demand and less percentage of demand met in minimum supply year than under current conditions.	Newlands Project: same demand and slightly less percentage of demand met in minimum supply year than under No Action; much less demand and less percentage of demand met in minimum supply year than under current conditions.	Newlands Project: same demand and slightly greater percentage of demand met in the minimum supply year than under No Action; much less demand and less percentage of demand met in minimum supply year than under current conditions.
	Lower Truckee River basin: much greater demand and same percentage of demand met in minimum supply year as under current conditions.	Lower Truckee River basin: same as under No Action.	Lower Truckee River basin: same as under No Action.
M&I	Lake Tahoe basin: much greater demand and same percentage of demand met in minimum supply year as under current conditions.	Lake Tahoe basin: same as under No Action.	Lake Tahoe basin: same as under No Action.
	Truckee River basin in California: much greater demand and the same percentage of demand met in minimum supply year as under current conditions.	Truckee River basin in California: same as under No Action.	Truckee River basin in California: same as under No Action.
	Truckee Meadows: much greater demand and less percentage of demand met in minimum supply year than under current conditions.	Truckee Meadows: same demand and greater percentage of demand met in minimum supply year than under No Action; much greater demand and less percentage of demand met in minimum supply year than under current conditions.	Truckee Meadows: same demand and greater percentage of demand met in minimum supply year than under No Action; much greater demand and less percentage of demand met in minimum supply year than under current conditions.

C. Reservoir Storage and Releases

1. Method and Operations Model Input Assumptions

This section describes the method used to calculate reservoir storage and releases and the supply and demand assumptions used in the operations model.

a. Method

The following sections provide information on the effects of the various alternatives on reservoir operations and resulting streamflows. Indicators were not selected for parameters in the Water Resources section in order to present model results objectively. These data are used selectively, however, to identify indicators in the resource sections that follow related to beneficial uses (e.g., exercise of water rights, minimum flows, recreation storage thresholds) and unique resources (e.g., special status species, fish, and riparian habitat) to provide an analytical basis for this document.

Operations model results for reservoir storage and releases and flows in wet, median, and dry hydrologic conditions (10-, 50-, and 90-percent exceedences) under No Action, LWSA, and TROA were compared to the results for modeled current conditions; results under LWSA and TROA also were compared to results under No Action. In addition, operations models results were analyzed to identify the causes of any differences between the alternatives and current conditions. See “General Methods and Assumptions, Use of the Truckee River Operations Model” for further explanation.

Tables in the Water Resources Appendix present reservoir storage and elevation and average monthly releases for each reservoir under current conditions, No Action, LWSA, and TROA, as generated by the operations model. The operations model input files, a description of what they represent, and output summary files are contained in the Water Resources Appendix. The output files are on file in BOR’s Lahontan Basin Area Office in Carson City, Nevada.

b. Input Assumptions

See “General Methods and Assumptions, Use of the Truckee River Operations Model.”

i. Water Supply

For current conditions, No Action, LWSA, and TROA, the operations model uses 100 years of historic hydrologic data for the period October 1900 to September 2000 to calculate the availability of water supply to meet demands. Historic flows (from gauging station records), estimated flows (when gauging station records were not available), and reservoir evaporation records were used to generate basic water supply data. Input values for initial reservoir storage were calculated by averaging the historic end-of-September storage for the period 1993-2002. This period is recent and represents a wide range of hydrologic conditions.

The operations model does not perform any operations calculations for demands in the Lake Tahoe basin. The effects of water demands were incorporated into the monthly net inflow data for Lake Tahoe and were assumed to be met with no shortages. Lake Tahoe inflow was developed assuming California demands of 23,000 acre-feet and Nevada demands of 11,000 acre-feet annually. (The current estimate of annual use is 18,700 acre-feet in California and 11,000 acre-feet in Nevada.) Because current demands are less than future demands, Lake Tahoe inflow was increased by 1,400 acre-feet per year in the current conditions simulation to account for less consumptive use in the Lake Tahoe basin.

ii. Water Demand

Table 3.11 presents annual consumptive demands in the study area that were included as input to the operations model.

(a) Current Conditions Modeled Demands

Current modeled demands were based on 2002 data. Currently, M&I demands for the Pyramid Tribe and Fernley are met by groundwater and are not modeled. Return flows from irrigation, river losses, and local inflow in Truckee Meadows were based on another computer model, the Truckee Meadows model, which estimates the net effects of urbanization on these parameters. Estimated return flow from TMWRF is 29,710 acre-feet per year. Minimum reservoir releases, hydroelectric plant bypass flows, and hydroelectric plant demands are shown in table 3.4. No recreational pool or water quality targets are modeled for current conditions. All operations discussed previously in “Current Operations” are modeled.

(b) No Action Modeled Demands

The operations model uses estimates of future demands for water based on population and water use projections made by water resource planning entities in California and Nevada: Washoe County, TMWA, TRPA, California Department of Finance, CDWR, Nevada Division of Water Resources, city of Fernley, and the Pyramid Tribe.

Under No Action, no additional storage facilities would be constructed to provide a drought supply for Truckee Meadows M&I demands. Surplus TMWA rights would be injected through wells into the groundwater. In drought years under No Action, the groundwater would be used conjunctively to supplement available surface water supplies.

In its 1995-2015 Water Resources Plan, Sierra Pacific (1994) evaluated a number of options to provide a reliable water supply for Truckee Meadows, including 18 alternative local reservoir projects. In its plan, Sierra Pacific recommended implementation of a number of water supply options and reconnaissance-level studies of potential dam sites, but it did not include construction of a new storage reservoir. Because TMWA has not proposed construction of a reservoir and a facility is not proposed under No Action, LWSA, or TROA, this study did not analyze a new reservoir component.

Table 3.11.—Modeled annual consumptive demands in study area (acre-feet)

Type	Current conditions	No Action	LWSA	TROA
M&I demands in California				
Lake Tahoe basin	18,700	23,000	23,000	23,000
Truckee River basin	8,570	20,600	20,600	20,600
M&I demands in Nevada				
Lake Tahoe basin	[1]11,000	11,000	11,000	11,000
M&I demands in Truckee Meadows, TMWA				
Normal	83,140	119,000	119,000	119,000
Drought	83,140	107,300	109,200	113,720
Other M&I demands				
Tracy hydroelectric plant[2]	1,950	3,500	3,500	3,500
Washoe County	9,900	21,750	21,750	21,750
Fernley	[3]0	[4]6,800	[4]6,800	[4]6,800
Pyramid Lake Indian Reservation	[5]0	[6]16,380	[6]16,380	[6]16,380
Agricultural demands in California				
Truckee River basin	1,800	2,100	2,100	2,100
Agricultural demands in Nevada				
Truckee Meadows	40,770	21,500	21,500	4,860
Newlands Project, Truckee Division	18,520	[7]0	[7]0	[7]0
Newlands Project, Carson Division	275,720	268,870	268,870	268,870
Lower Truckee River	12,040	[6]17,900	[6]17,900	[6]17,900
Out-of-basin exports in California				
To Sierra Valley	7,000	7,000	7,000	7,000
To South Fork of American River	2,000	2,000	2,000	2,000
To Carson River[8]	3,800	4,700	4,700	4,700
Out-of-basin exports in Nevada				
To Carson River[9]	5,000	6,500	6,500	6,500
To Stead (supplied by TMWA)	1,680	1,680	1,680	1,680

[1] This was the assumed demand when the operations model was run; recent information reveals current demand to be 9,379 acre-feet.
[2] Modeled as depletion (i.e., no return flow).
[3] Current demand of 3,280 acre-feet supplied by local groundwater sources.
[4] Transfer of 6,800 acre-feet of Truckee Division agricultural water rights would provide a portion of the future demand of 29,500 acre-feet; supply for the additional 22,700 acre-feet has not been identified and was not modeled.
[5] Current demand of 1,120 acre-feet supplied by local groundwater sources.
[6] Includes portions of full exercise of *Orr Ditch* Claim Nos. 1 and 2.
[7] Assumes all Truckee Division water rights are acquired and transferred for WQSA and local M&I, although some agricultural rights are likely to remain in the future.
[8] Sewage effluent from South Tahoe Public Utility District.
[9] Sewage effluent from Incline Village General Improvement District, Douglas County Sewer Improvement District No. 1, and diversions from Marlette Lake.

(i) Consumptive Demands

(aa) Agriculture

In the future, surface water supplies would continue to meet agricultural demand in the Truckee River basin. Annual agricultural demand in the Truckee River basin in California is expected to increase by 300 acre-feet. Agricultural demand in the Truckee River basin in Nevada is expected to decrease under No Action from 40,770 to 21,500 acre-feet per year as a result of urbanization. Agricultural demand in the Truckee Division is projected to decrease from 18,520 to 0 acre-feet per year. Reno, Sparks, Washoe County, and the Federal Government are projected to acquire approximately 10,300 acre-feet of agricultural rights from the Truckee River basin and the Truckee Division for water quality purposes, and the city of Fernley and TMWA are projected to acquire additional agricultural water rights for M&I use. Truckee Division agricultural water rights not acquired for WQSA are projected to be acquired by Fernley. Carson Division demand is projected to be lower because of the purchase of water rights under the Water Rights Acquisition Program for Stillwater National Wildlife Refuge (WRAP). Water rights purchased under WRAP (bottom and bench land with respective duties of 3.5 and 4.5 acre-feet per acre) are transferred to the wetlands at 2.99 acre-feet per year. The operations model assumes that under current conditions, 21,300 acre-feet of water rights are dedicated to the wetlands and that under the alternatives, an additional 41,600 acre-feet would be purchased and transferred by 2033. As a result, the Carson Division demand decreases from 275,720 acre-feet under current conditions to 268,870 acre-feet under the alternatives. The goal of WRAP is to transfer 125,000 acre-feet of water to the wetlands. Of that 125,000 acre-feet, 60,000 to 64,000 acre-feet of Carson Division water rights would be purchased. The additional water is to be provided by 19,700 acre-feet of drainage, 9,700 acre-feet of spills, and 33,600 acre-feet comprised of upstream Carson River water rights, groundwater, Navy conservation, and other sources.

Lower Truckee River agricultural demand is expected to increase from 12,040 to 17,900 acre-feet per year using Claim Nos. 1 and 2 and other water rights.

(bb) M&I

In California, total M&I demand in the Truckee River basin is projected to increase from 27,270 to 43,600 acre-feet per year; groundwater is expected to primarily meet the increased demand. Demand in the Lake Tahoe basin is expected to increase from 18,700 to 23,000 acre-feet per year, while demand in the Truckee River basin is expected to increase from 8,570 to 20,600 acre-feet per year. The surface water component of the Truckee River basin demand is projected to remain at 1,000 acre-feet per year.

Exports of water from the Truckee River basin are projected to be greater than under current conditions (6,500 acre-feet compared to 5,000 acre-feet).

In Nevada, total M&I demand in the Truckee River basin is projected to increase from approximately 96,600 to 166,500 acre-feet per year because of population increases, primarily in Truckee Meadows. M&I demand is projected to increase from 83,140 to

119,000 acre-feet per year in Truckee Meadows. To meet the increased demand, TMWA is expected to acquire additional Truckee Meadows agricultural water rights for a total of 83,030 acre-feet.

Groundwater reservoirs would be operated conjunctively with other supplies to meet M&I demands in drought years. As modeled, conservation is used to satisfy a decreased demand when less than a full water supply is available (in dry years).

M&I demand in the Lake Tahoe basin in Nevada is expected to remain at 11,000 acre-feet per year. Tracy hydroelectric plant demand is projected to increase from 1,950 to 3,500 acre-feet per year. Fernley M&I demand is projected to increase from 3,610 to 29,500 acre-feet per year, and the Pyramid Tribe's demand is projected to increase from 1,120 to 16,380 acre-feet per year. Transfer of 6,800 acre-feet of Truckee Division agricultural water rights would provide a portion of the future Fernley demand of 29,500 acre-feet. This amount is modeled under the alternatives; the remaining 22,700 acre-feet is not modeled.

(ii) Nonconsumptive Demands

As previously discussed, the cities of Reno and Sparks, Washoe County, and the Federal Government are expected to purchase agricultural surface water rights from the Truckee River basin. In addition to these surface water rights, under TROA TMWA is required to provide 6,700 acre-feet of additional existing Truckee Meadows water rights.

Currently, 3,133 acre-feet of surface water rights have been purchased in the Truckee Division under this program. Based on water rights available, current pricing, and inflation for the duration of the program, it is estimated that a total of 10,311 acre-feet in the Truckee Division, 2,000 acre-feet of *Orr Ditch* water rights between Vista and Wadsworth, and 900 acre-feet in the Truckee Meadows would be purchased by the program. Calculation of this estimate is presented in the Water Resources Appendix. These water rights would be used to improve Truckee River water quality by increasing flow from June through September to meet flow targets and, consequently, enhancing the river's capacity to assimilate nutrients. Water quality flow targets at Sparks and Nixon are shown in chapter 2.

Minimum and hydropower bypass flows and recreational pool targets would be the same as under current conditions. Pyramid Lake fish flows would be selected using the same criteria as under current conditions.

(c) LWSA Modeled Demands

Total consumptive and nonconsumptive demands would be the same under LWSA as under No Action, except that California Truckee River M&I surface water component would increase from 1,000 to 2,200 acre-feet and the groundwater component would decrease by 1,200 acre-feet. For modeling purposes, California’s additional surface water demand is assumed to be diverted from the Truckee River just downstream from the confluence with Donner Creek. TMWA would exercise its water rights to provide an additional 1,000 acre-feet per year to groundwater recharge, resulting in an increase in groundwater pumping under drought conditions from 22,000 acre-feet to 26,500 acre-feet. As under No Action, the operations model assumes that conservation measures would only be implemented in dry years. Modeled operations are the same as under No Action.

(d) TROA Modeled Demands

TROA would modify existing operations of all reservoirs to enhance coordination and flexibility. Flood control and dam safety requirements and existing water rights would be served as under current operations. TROA would allow signatory parties the opportunity to store and exchange Credit Water in all reservoirs. See the Water Resources Appendix for a detailed discussion of Credit Water operations and examples of model calculations.

The operations model uses similar demands for TROA as for No Action, as follows.

(i) Consumptive Demands

(aa) Agriculture

The operations model assumes that agricultural demand in the Truckee River basin in California is the same under TROA as under LWSA and agricultural demands in the lower Truckee River and the Newlands Project are the same as under No Action. However, the amount of Truckee Meadows agricultural water rights acquired and transferred to M&I use by TMWA is anticipated to be greater under TROA than under the No Action. Because TROA would require 1.11 acre-feet of water rights for every acre-foot of new service commitment (versus 1 acre-foot per acre-foot of commitments under No Action and LWSA), TMWA projects that at total of 93,550 acre-feet of agricultural rights would be acquired. The remaining 0.11 acre-foot would be used to accumulate TMWA M&I Credit Water. (See page 6 of attachment C for detailed explanation.)

(bb) M&I

Anticipated future populations in the Lake Tahoe and Truckee River basins in California are projected to be the same as under No Action. P.L. 101-618 limits Lake Tahoe basin water use by both California and Nevada to 23,000 and 11,000 acre-feet per year, respectively. See "General Methods and Assumptions" for more information about the development of population projections.

The operations model assumes total Nevada M&I demand in the Truckee River basin is the same under TROA as under No Action. TMWA's demand in Truckee Meadows is projected to be 119,000 acre-feet per year, securing a total of 93,550 acre-feet of Truckee Meadows agricultural water rights.

Under TROA, storage of surplus TMWA diversion rights and TMWA Private Water released from Donner and Independence Lakes is required to provide drought supplies.

TMWA may store an unlimited amount of TMWA M&I Credit Water before April 1. In a drought year, this water may be used to meet M&I demands.

In a non-drought year, TMWA would be permitted to store up to a maximum 20,000 acre-feet of water after April as Non-Firm TMWA M&I Credit Water when TMWA's normal year demand is 119,000 acre-feet and California's depletion is 16,000 acre-feet per year in the Truckee River basin. The operations model assumes a California depletion of 11,610 acre-feet per year. (See detailed computations in the Water Resources Appendix.) This depletion limits the Non-Firm TMWA M&I Credit Water to 16,630 acre-feet when TMWA demand is 119,000 acre-feet. Under TROA (and as modeled) TMWA would be permitted to store a maximum of 12,000 acre-feet after April 1 as Firm TMWA M&I Credit Water. TMWA Emergency Credit Water of 7,500 acre-feet also would be established.

The operations model uses TMWA M&I Credit Water conjunctively with other supplies to meet demands in drought situation. In a Drought Situation, TMWA would be required to implement conservation measures. If TMWA's normal water supplies and releases of Private Water from Donner Lake are not sufficient to meet these reduced demands and Independence Private Water is less than 7,500 acre-feet, then Non-Firm TMWA M&I Credit Water, followed by Firm TMWA M&I Credit Water, could be released. When a Drought Situation exists, Non-Firm TMWA M&I Credit Water in excess of the base amount would be retained for use later in that year.

The operations model assumes that Fernley and Pyramid Lake Indian Reservation M&I demands are the same under TROA as under No Action. Under both No Action and TROA, Fernley is assumed to purchase surface water rights in the Truckee Division. Fernley would have an opportunity to store any excess surface water rights as Credit Water under TROA. Because no terms for storage have been agreed to, however, the operations model includes no such Credit Waters and exercises all acquired Fernley water rights to meet immediate demands. Potential effects of storage were considered in a separate analysis ("Optional Scenarios") presented at the end of "Water Resources." The potential effects of TMWA's acquisition of TCID's portion of Donner Lake storage also were analyzed.

The operations model assumes that Nevada and California M&I demand in the Lake Tahoe basin and California M&I demand on the Truckee River are the same under TROA as under No Action. Under TROA, the operations model assumes California is allowed to store as much as 8,000 acre-feet each year as California M&I Credit Water to supply its M&I surface water diversions later in the year. The storage is accumulated in Lake Tahoe by reducing releases that would otherwise be made and allocating water associated with a water right from the Truckee River downstream from Lake Tahoe to replace the water that would otherwise have been released from Lake Tahoe. By exchange, California water stored in Lake Tahoe may be transferred to another Truckee River reservoir, but the maximum of 3,000 acre-feet of the 8,000 total could be held outside of Lake Tahoe. Accumulation of California M&I Credit Water is further restricted in the operations model to no more than 25 percent of the annual entitlement in any one month. TROA would allow new facilities to be built in California, but space for California M&I Credit Water in Federal reservoirs would be reduced for any amount over 2,500 acre-feet. The operations model does not simulate operation of any new California storage facilities. Exports from the Truckee River basin are projected to be the same as under No Action. TROA also would allow imported water to be stored as Credit Water. The operations model does not simulate any specific import proposal.

(ii) Nonconsumptive Demands

The operations model assumes that nonconsumptive demands on the Truckee River for hydroelectric power generation, lower Truckee River flows, and minimum reservoir releases, except from Independence Lake and Prosser Creek Reservoir, are the same under TROA as under No Action. In addition, the operations model incorporates new minimum releases from Independence Lake and Prosser Creek, revised hydropower bypass requirements, preferred and enhanced minimum flow targets, and recreational pool targets. The revised minimum Prosser Creek release is 5 cfs, and the Independence Lake minimum releases are computed using the criteria shown in table 2.8. All hydroelectric plant diversion dams on the Truckee River are modeled to bypass a minimum of 50 cfs, or streamflow immediately upstream of the diversion dam, whichever is less, plus any Fish Water up to 100 cfs, to achieve a bypass of 150 cfs.

The operations model uses seasonal forecasts to select reservoir releases when flows greater than the minimum can be maintained. These releases do not use Floriston Rate Water unless it is being released for the exercise of *Orr Ditch* Decree water rights. Releases are selected with a “most desirable” target based upon preferred flows established by CDFG and incorporated in the California Guidelines. The operations model uses the following preferred releases:

Lake Tahoe	250 cfs October through January 150 cfs February through March and August through September 300 cfs April through July
Donner Lake	50 cfs October through January and April through July 20 cfs February through March 10 cfs August through September
Prosser Creek Reservoir	50 cfs October through January 35 cfs February through March 75 cfs April through July 30 cfs August through September
Independence Lake	20 cfs October through January and April through July 10 cfs February through March and August through September
Stampede Reservoir	125 cfs October through January and April through July 100 cfs February through March and August through September
Boca Reservoir	None required

The operations' model procedure for establishing flow targets varies by month, as follows:

- October through January: Release targets are adjusted to equal minimum flows.

- February through May: The capacity to make releases between the minimum and preferred through June is calculated; the release targets are adjusted each month based on the updated forecast.

- June: Release targets are the minimums because operations provide releases greater than the minimums.

- July through September: Release targets are based on scheduled release through October in conjunction with the minimum and preferred flows.

The operations model uses the following recreational pool targets (acre-feet) for May through August.

Lake Tahoe	None
Donner Lake	8,800
Prosser Creek Reservoir	19,000
Independence Lake	10,500
Stampede Reservoir	127,000
Boca Reservoir	33,500

California has the option under TROA to exercise additional surface water rights, which may be used to accumulate California M&I Credit Water. For this analysis, it was estimated that California would exercise an additional 300 acre-feet rights per year. Up to 8,000 acre-feet could be stored at any time. California water stored in Lake Tahoe may be exchanged to another Truckee River reservoir.

Under TROA, a portion of Fish Credit Water would be designated as Joint Program Fish Credit Water (JPFCW). The total amount of JPFCW in storage at any time in the Truckee River reservoirs cannot exceed 20,000 acre-feet. In the operations model, JPFCW is transferred among reservoirs with an objective of maintaining recreation pools. When no other supplies are available, JPFCW is used to maintain minimum releases.

Some of the operations provided for under TROA are not modeled because projects have not been identified, approvals have not been secured, or implementation would depend on uncertain environmental variables. Some examples follow.

- Storage of imported water in Truckee River reservoirs as Other Credit Water

- Water-related emergencies inconsistent with TROA

- Maintenance of a dam or other water or power facility

- Pumping of Sparks Marina Lake
- Release of water for removal of ice from hydropower facilities and Highland Ditch
- Pumping of Lake Tahoe or Independence Lake
- Construction of a new water storage facility
- Transfer of Sierra Valley Decree water rights to Truckee River basin
- Additional California Environmental Credit Water
- Use of water for snowmaking
- Storage and release of Other Credit Water
- Design of water wells in the Truckee River basin in California

2. Model Results

Water stored in and released from reservoirs are indicators of water availability to meet water demands and serve a number of beneficial uses. Total monthly reservoir storage (excluding Lahontan Reservoir) and end-of-month storage and average monthly releases for each reservoir analyzed are shown in the following figures:

Figures

Location	Storage	Releases
All reservoirs	3.3	
Lake Tahoe	3.4	3.5
Donner Lake	3.6	3.7
Prosser Creek Reservoir	3.8	3.9
Independence Lake	3.10	3.11
Stampede Reservoir	3.12	3.13
Boca Reservoir	3.14	See discussion
Lahontan Reservoir	3.15	3.16

Figures comparing storage and releases for each lake and reservoir in wet, median, and dry hydrologic conditions (10-, 50-, and 90-percent exceedences) under each alternative are shown in the Water Resources Appendix.

a. Current Conditions

i. Total Water in Storage Upstream of Farad

Operations model results show that under current conditions, total reservoir storage in the Truckee River basin is constant from October through February, when flood control criteria may restrict storage. The reservoirs fill from March through June with spring runoff and snowmelt; releases to meet water demands are made year-round but are greatest from June through September. In wet hydrologic conditions, total storage ranges from a minimum of approximately 871,000 acre-feet in November to a maximum of 1,056,000 acre-feet in July. In median and dry hydrologic conditions, minimum storage occurs in December and maximum storage normally occurs in June. Storages range from 689,000 to 951,000 acre-feet in median hydrologic conditions and 29,000 to 148,000 acre-feet in dry hydrologic conditions. See figure 3.3.

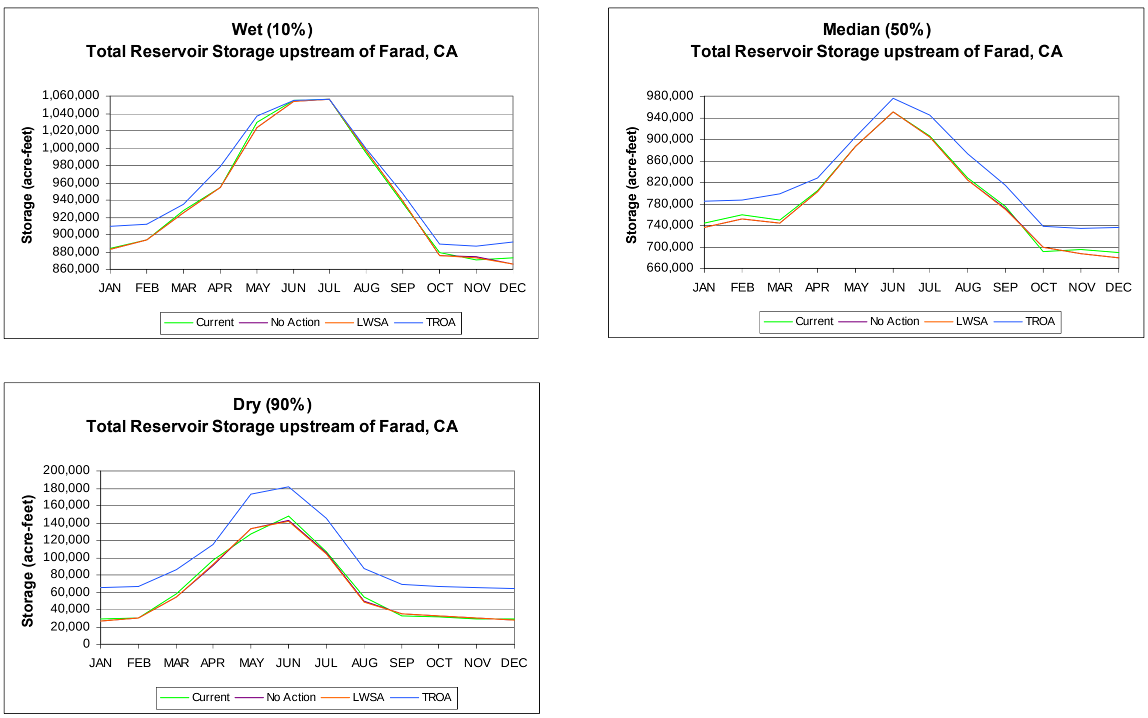


Figure 3.3.—Modeled total water in storage upstream of Farad.

ii. Lake Tahoe

Lake Tahoe accounts for about 70 percent of the total reservoir storage space in the Truckee River system. Operations model results show that under current conditions, Lake Tahoe storage ranges widely, from a maximum of 732,000 acre-feet in wet hydrologic conditions to a minimum of –30,700 acre-feet in dry hydrologic conditions (figure 3.4). (Note: Negative storage indicates the lake is below its natural rim elevation of 6223 feet; releases cannot be made when storage is negative.)

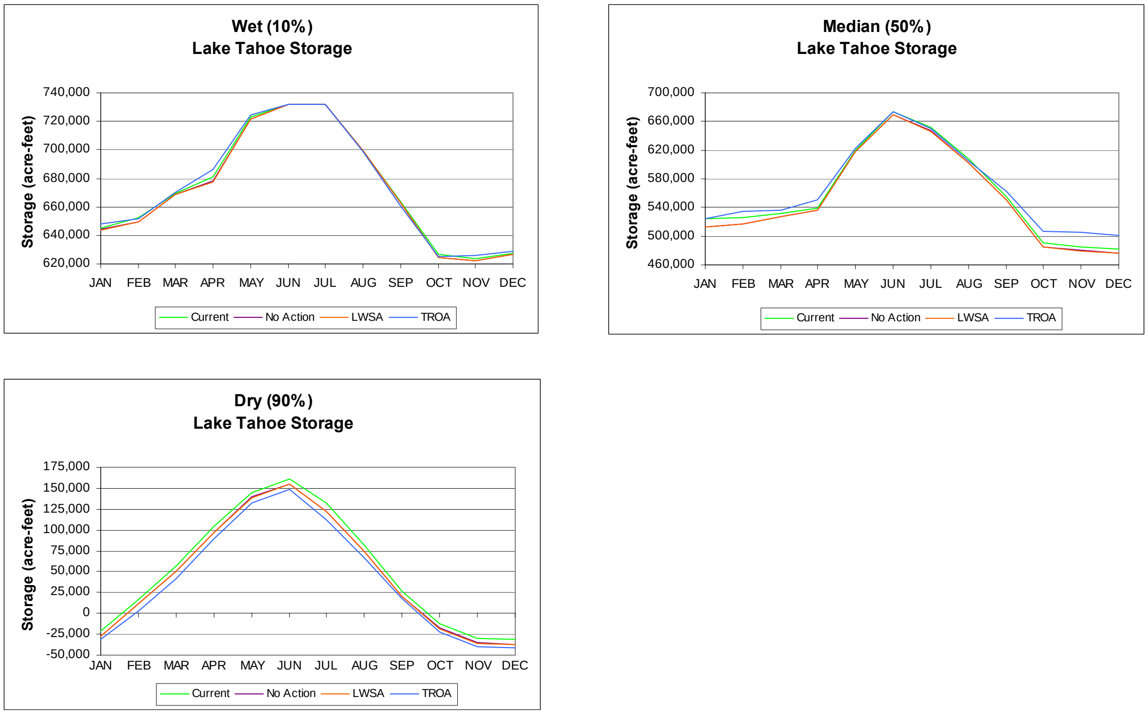


Figure 3.4.—Modeled Lake Tahoe storage.

Lake Tahoe releases are shown in figure 3.5. In wet hydrologic conditions, releases are made during the winter to limit high-water damage to lakeshore property and ensure that lake does not exceed elevation 6229.1 feet (storage of 732,000 acre-feet) and during the summer to meet streamflow requirements. The maximum monthly release is 3,030 cfs, and the minimum is 0 cfs.

iii. Donner Lake

Operations model results show that under current conditions, Donner Lake storage ranges from a maximum of 9,500 acre-feet from May to August in wet hydrologic conditions to a minimum of 2,890 acre-feet from November through February in dry hydrologic conditions (figure 3.6). In May, Donner Lake fills in both wet and median hydrologic conditions. Storage reaches only 8,300 acre-feet in dry hydrologic conditions.

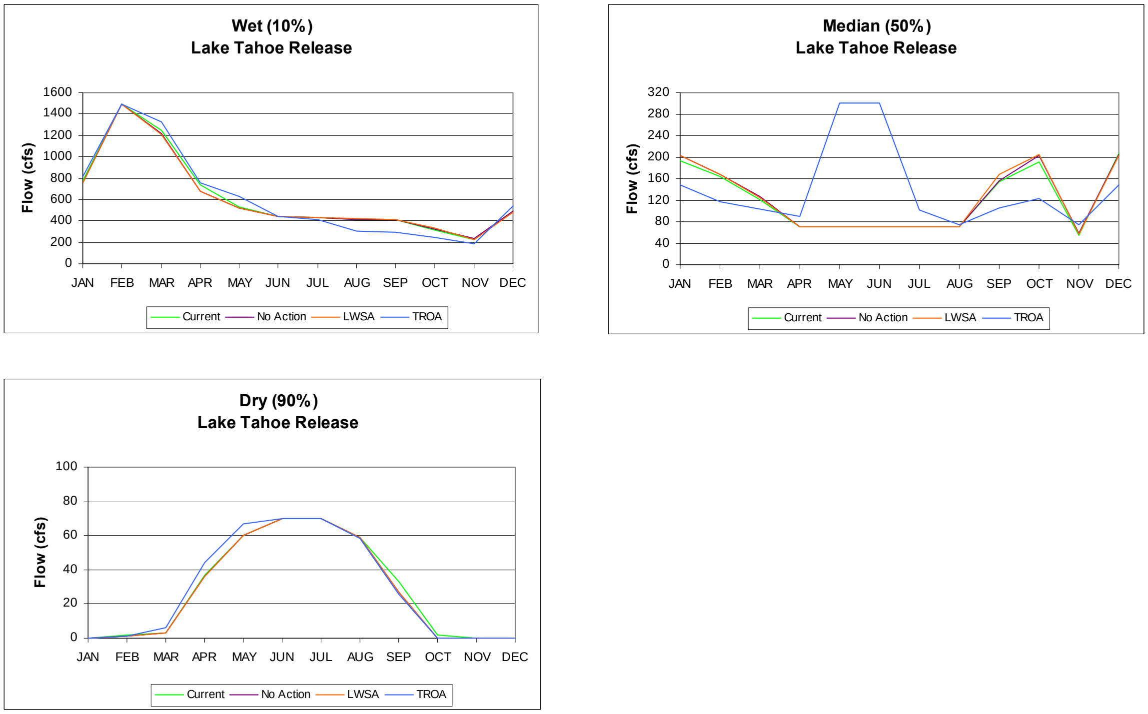


Figure 3.5.—Modeled Lake Tahoe releases.

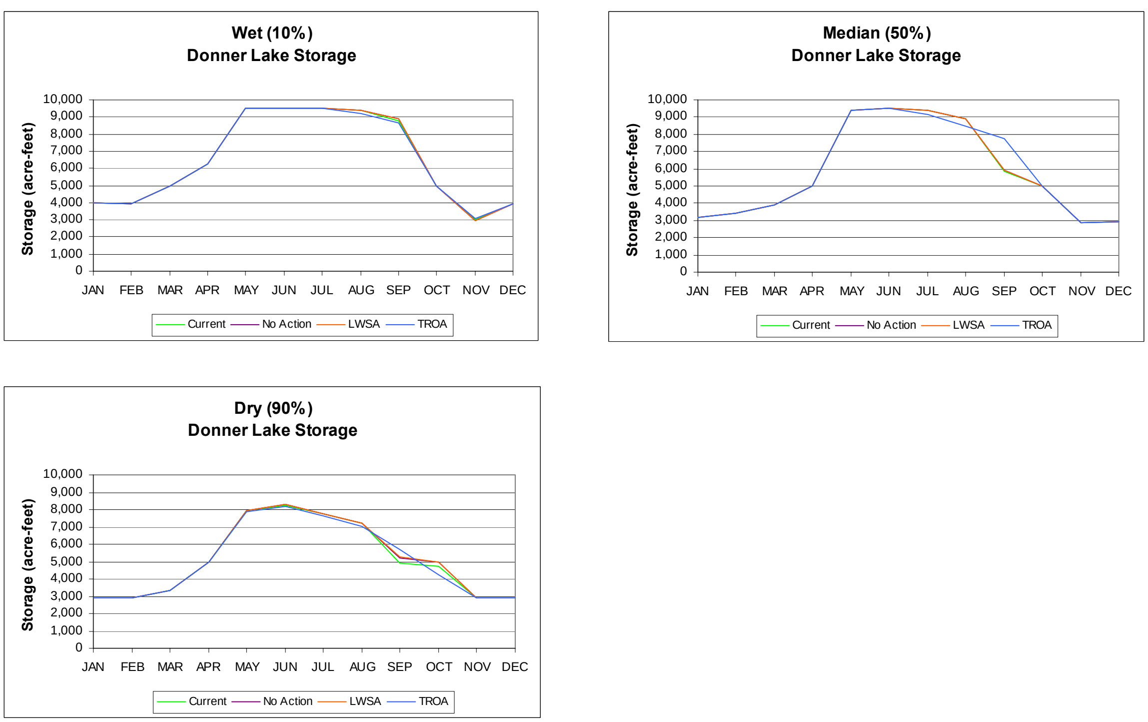


Figure 3.6.—Modeled Donner Lake storage.

Operations model results show a similar pattern of releases in median and dry hydrologic conditions (figure 3.7): releases are restricted to minimums from July through August to maintain storage for releases to meet demands in September and to attempt to meet recreational pool targets. A maximum average monthly release of 140 cfs occurs from May through June in wet hydrologic conditions, and a minimum of 2 cfs occurs from June through August in dry hydrologic conditions. The “spike” in September releases is the result of evacuating storage to meet dam safety requirements to lower reservoir storage to 3,000 acre-feet (the sill of the outlet works) by November 1. Below this, no releases can be made. In wet hydrologic conditions, reservoir storage is about 4,000 acre-feet from December through February because even though the gates are open, the outlet is restricted and inflow is greater than the outlet’s capacity to make releases.

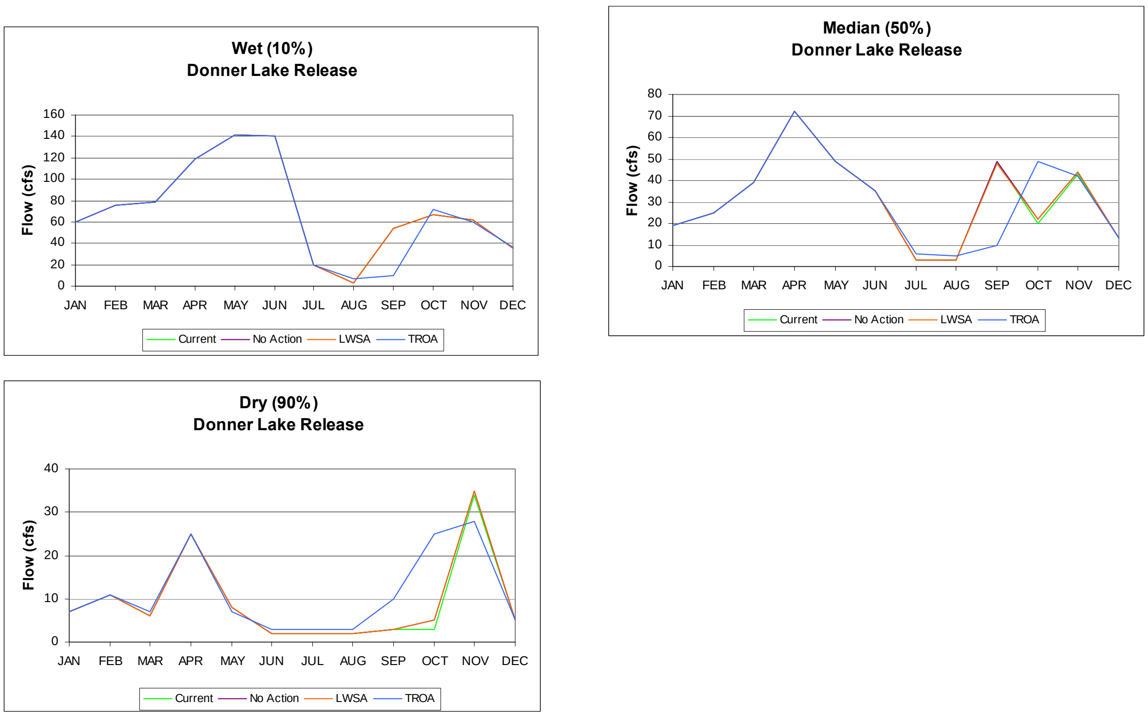


Figure 3.7.—Modeled Donner Lake releases.

iv. Prosser Creek Reservoir

Operations model results show that under current conditions, Prosser Creek Reservoir storage ranges from a maximum of 29,800 acre-feet in June in wet and median hydrologic conditions to a minimum of 1,600 acre-feet from July through February in dry hydrologic conditions (figure 3.8). In wet and median hydrologic conditions, the reservoir stores water in excess of Floriston Rate requirements and subject to TPEA from April through June. Storage declines from June through October as releases are made to meet demands and as TPEA water is released to meet Floriston Rates. Releases are made to lower storage to 9,800 acre-feet from October through March to meet flood control requirements. In dry hydrologic conditions, reservoir storage reaches a maximum of 9,000 acre-feet. Storage in median and dry hydrologic conditions is 76 and 16 percent of that in wet hydrologic conditions, respectively.

Figure 3.8.—Modeled Prosser Creek Reservoir storage.

Prosser Creek Reservoir releases Project Water from April through June to meet Floriston Rates and Newlands Project demands. The reservoir releases Project Water to enhance spawning of Pyramid Lake fishes from June through October and releases Tahoe-Prosser Exchange Water from June through August. In wet hydrologic conditions, the maximum release is 500 cfs in May, while in dry hydrologic conditions, the maximum release is 50 cfs. Minimum releases are made from July through the following February in dry hydrologic conditions as storage approaches minimum. Figure 3.9 shows Prosser Creek Reservoir releases.

v. Independence Lake

Operations model result show that under current conditions, Independence Lake storage ranges from a maximum of 17,200 acre-feet from June through August in wet hydrologic conditions to a minimum of 13,800 acre-feet in dry hydrologic conditions, November to January (figure 3.10). Operations model results show similar storage and release patterns in all hydrologic conditions. The reservoir is evacuated for dam safety reasons to a maximum storage of 15,000 acre-feet in the fall and winter. The reservoir fills from April through June, and releases are generally equal to inflow until August. Storage in median and dry hydrologic conditions is 99 and 95 percent of that in wet hydrologic conditions, respectively. Independence Lake storage tends to be held in reserve to meet Truckee Meadows M&I demands in water-short years.

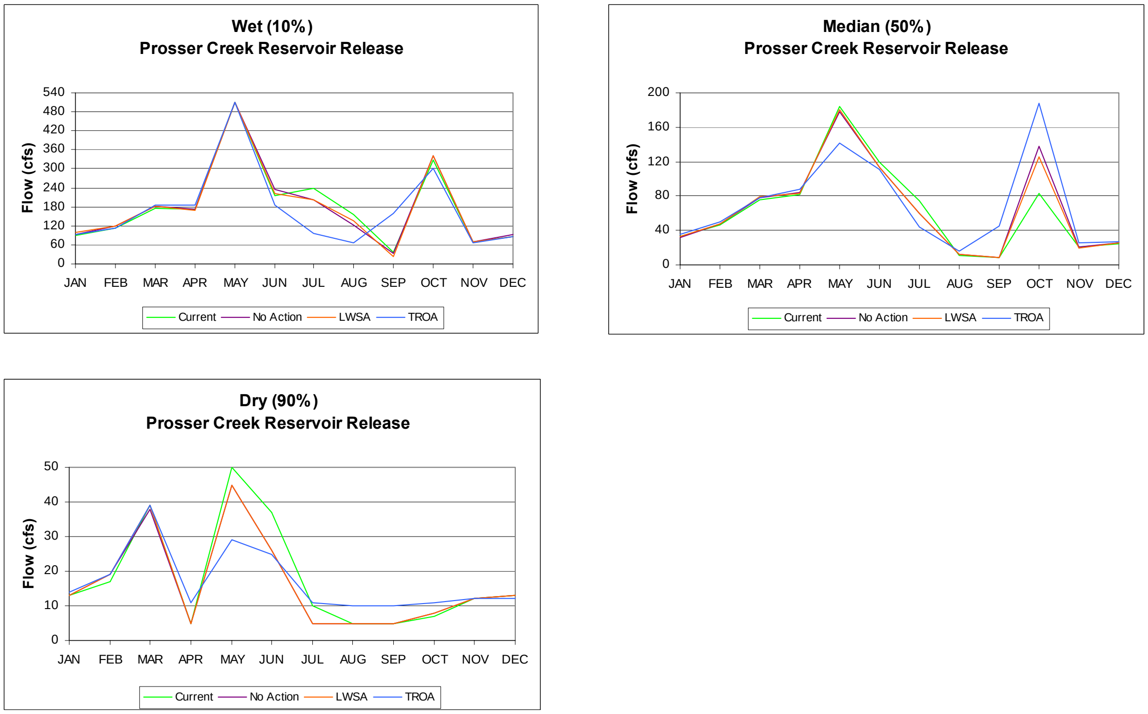


Figure 3.9.—Modeled Prosser Creek Reservoir releases.

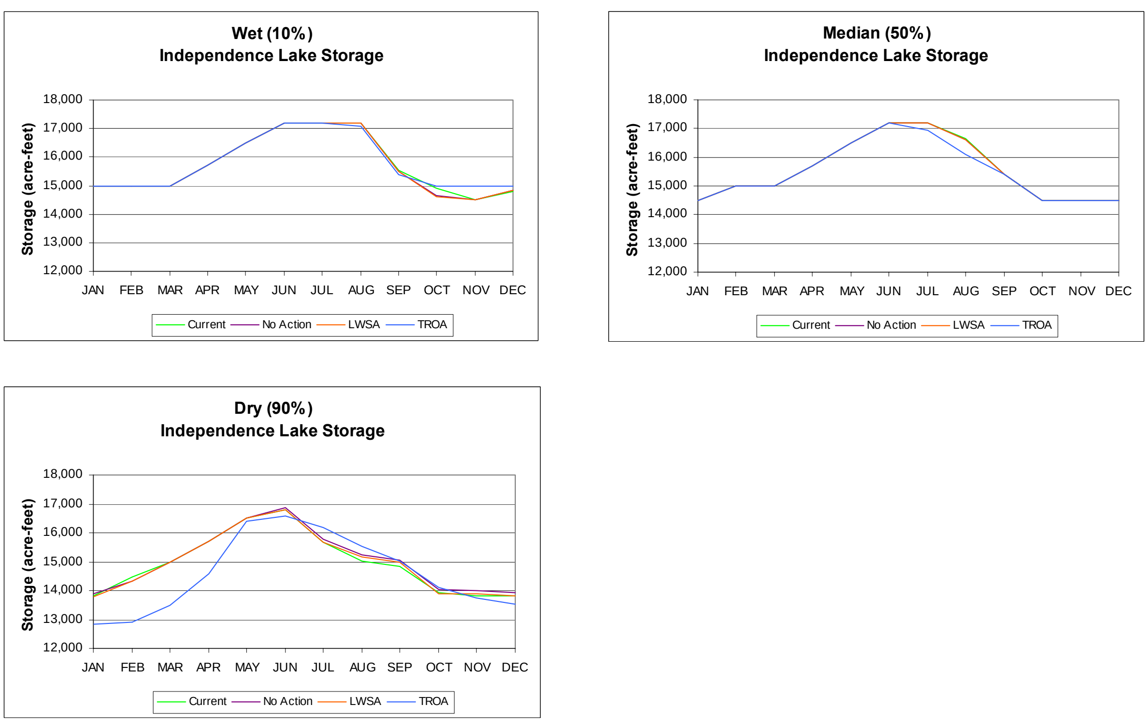


Figure 3.10.—Modeled Independence Lake storage.

Releases to meet Truckee Meadows M&I demands are normally made from August through October. A maximum release of 1,900 cfs occurs in June in wet hydrologic conditions, and a minimum of 2 cfs from July through September in dry hydrologic conditions. Minimum flows are met in all months. Figure 3.11 shows Independence Lake releases.

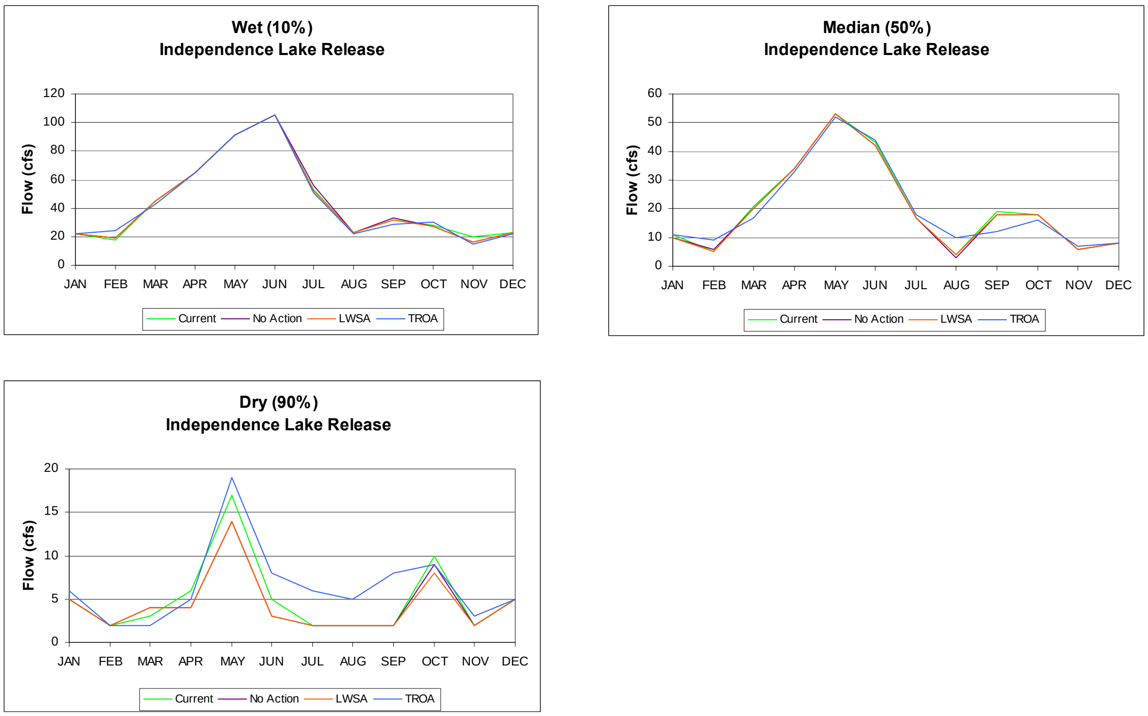


Figure 3.11.—Modeled Independence Lake releases.

vi. Stampede Reservoir

Operations model results show that under current conditions, storage ranges from a maximum of 226,500 acre-feet in July in wet hydrologic conditions to a minimum of 12,900 acre-feet in December and January in dry hydrologic conditions (figure 3.12). In all three hydrologic conditions, the reservoir stores between March and May. Based upon reservoir storage and forecast seasonal reservoir inflow, flow targets are set for the lower Truckee River for each month of the year. When these targets are not met, releases are made to increase flow in the lower Truckee River to meet the targets. In wet hydrologic conditions, releases are made from October to March to maintain maximum reservoir storage of 204,500 acre-feet. Storage in median and dry hydrologic conditions is 85 and 10 percent of that in wet hydrologic conditions, respectively.

Generally, releases are made from March through July to pass through water for Floriston Rates and to enhance Pyramid Lake fish spawning in the lower Truckee River. As noted previously, lower Truckee River flow targets for the remainder of the year are met with Stampede Reservoir release of Project Water when necessary. Maximum releases of 900 cfs occur in May in wet hydrologic conditions, and minimum releases of 30 cfs occur from August through the following February in dry hydrologic conditions. Figure 3.13 shows Stampede Reservoir releases under current conditions.

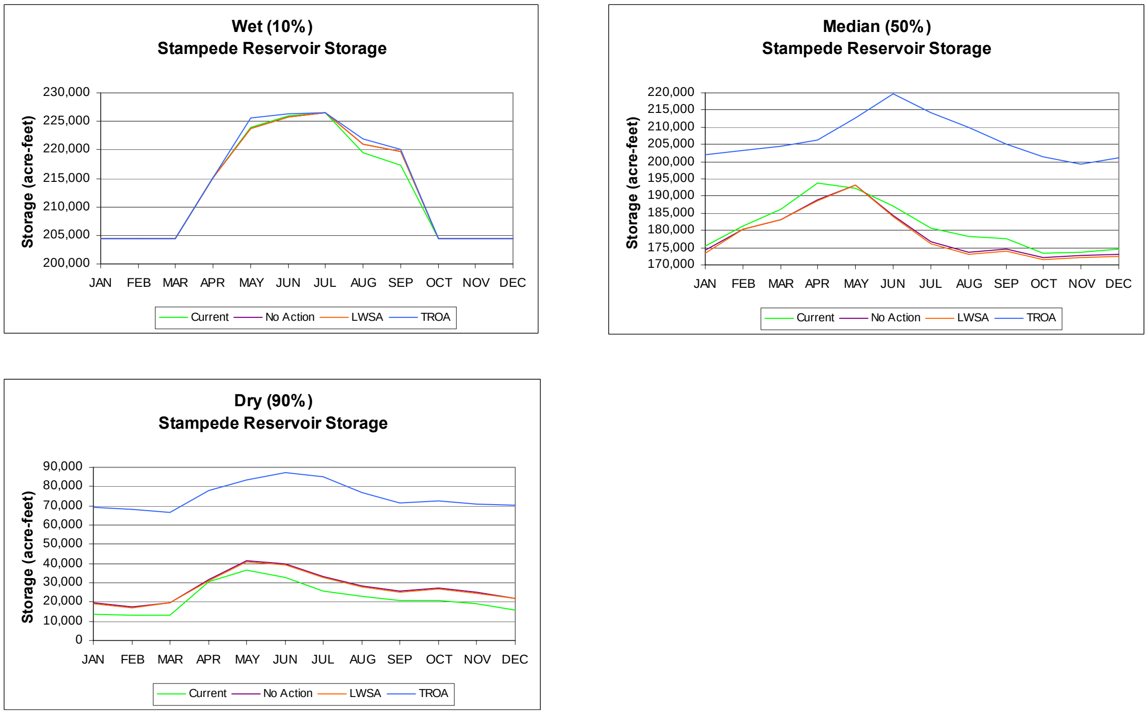


Figure 3.12.—Modeled Stampede Reservoir storage.

Figure 3.13.—Modeled Stampede Reservoir releases.

vii. *Boca Reservoir*

Operations model results show that Boca Reservoir storage ranges from a maximum of 40,900 acre-feet from May through July in wet hydrologic conditions to no storage from December through the following March in dry hydrologic conditions (figure 3.14). Releases are generally made in September and October to meet downstream demands and to pass releases from Independence Lake and Stampede Reservoir. Storage generally occurs from November to May. Releases are made to meet Floriston Rates and to pass Stampede Reservoir releases from March through September. Storage in median and dry hydrologic conditions is 59 and 10 percent of that in wet hydrologic conditions, respectively.

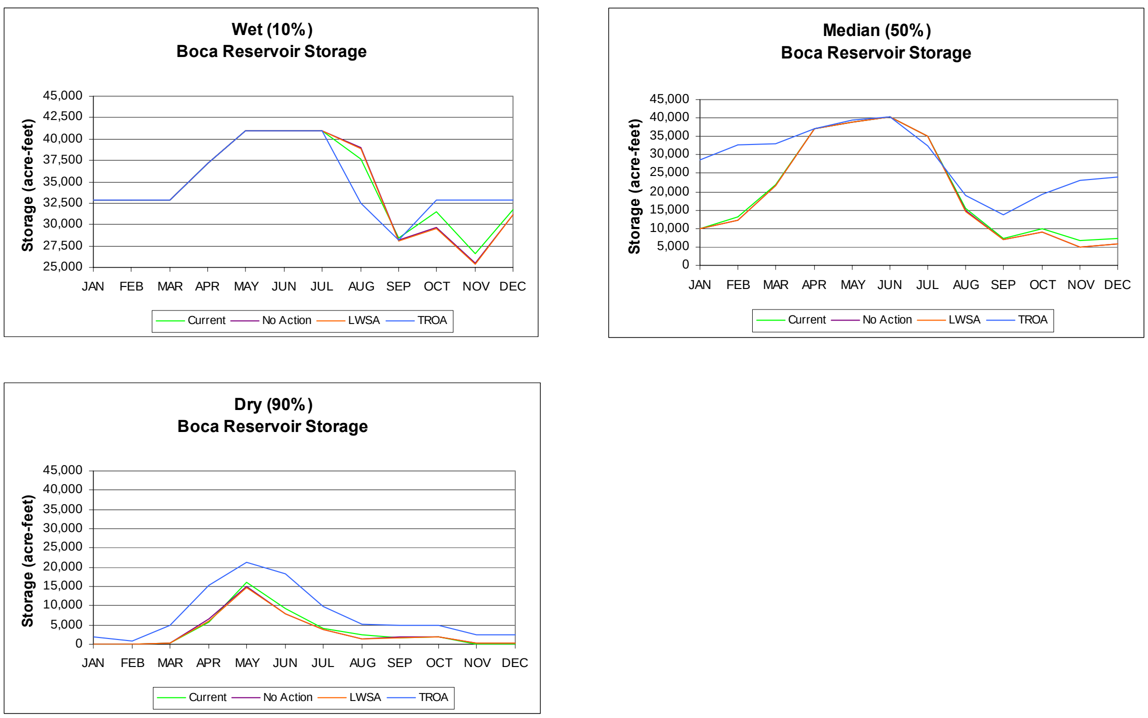


Figure 3.14.—Modeled Boca Reservoir storage.

Releases from Boca Reservoir are highly variable because of Stampede Project Water operations and cannot be characterized for wet, median and dry hydrologic conditions. Exceedence frequency values for Boca Reservoir releases are not indicative of the hydrologic conditions and were not evaluated as such.

viii. *Lahontan Reservoir*

Reservoir storage patterns at Lahontan Reservoir are very similar in all hydrologic conditions (figure 3.15). Inflow is stored from October through the following March. March through October releases are made to meet downstream demands; any inflow in excess of demand is stored. Maximum storage in wet hydrologic conditions is 316,900 acre-feet; minimum storage in dry hydrologic conditions is 31,200 acre-feet. Storage in median and dry hydrologic conditions is 58 and 36 percent of that in wet hydrologic conditions, respectively.

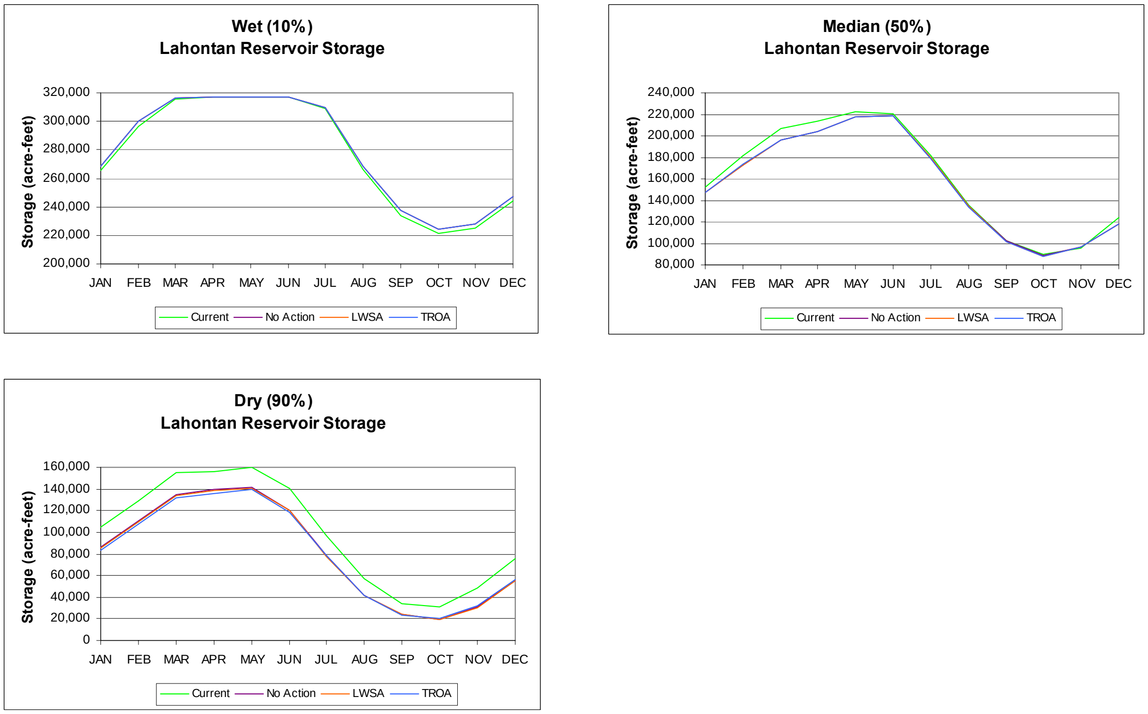


Figure 3.15.—Modeled Lahontan Reservoir storage.

In wet hydrologic conditions, releases are made from February through June to release flood waters and from July to November to meet downstream demands. In median and dry hydrologic conditions, releases are made from March through November to meet Carson Division demands. In all three hydrologic conditions, Carson Division demands are met and the release pattern is the same in median and dry hydrologic conditions. No releases are made from Lahontan Reservoir from December to February. Figure 3.16 shows Lahontan Reservoir releases.

3. Evaluation of Effects

a. No Action

i. Total Water in Storage Upstream of Farad

Total reservoir storage is slightly less (less than 1 percent) under No Action than under current conditions (figure 3.3). The difference is attributable to greater future M&I demand in the Lake Tahoe and Truckee River basins.

ii. Lake Tahoe

Operations model results show that Lake Tahoe storage is about 5,000 acre-feet less under No Action than under current conditions (less than 1 percent of total storage capacity), which is attributable to greater future demand for M&I water in the Lake Tahoe basin (figure 3.4).

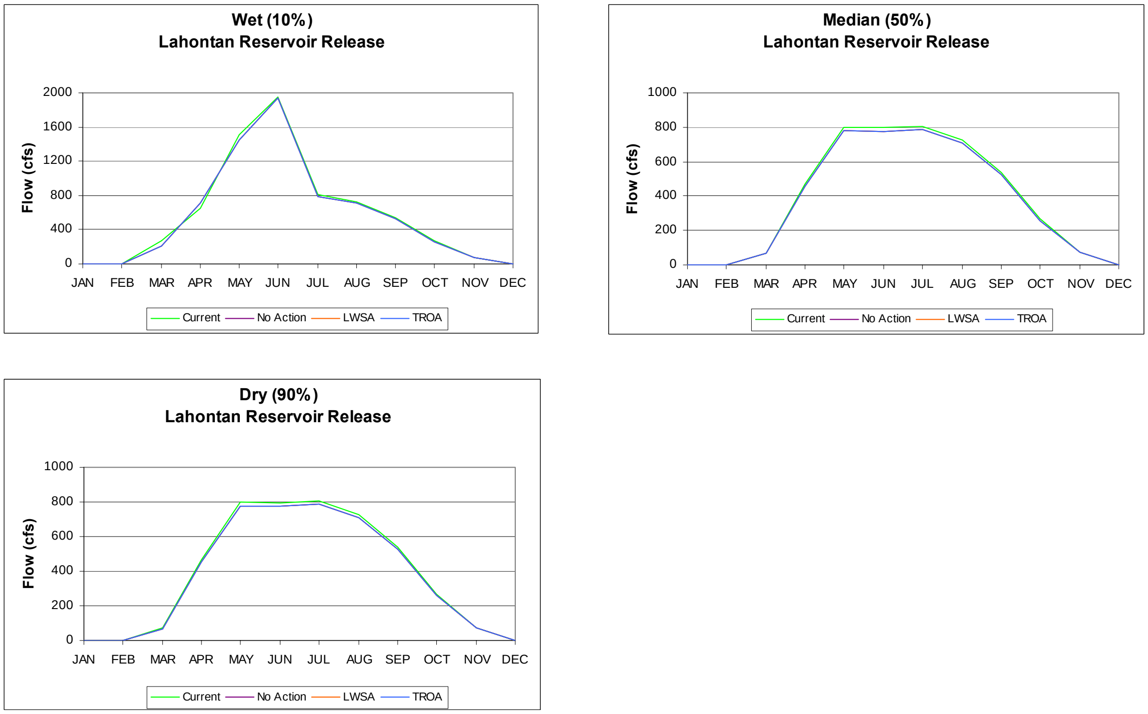


Figure 3.16.—Modeled Lahontan Reservoir releases.

ii. Lake Tahoe

Operations model results show that Lake Tahoe storage is about 5,000 acre-feet less under No Action than under current conditions (less than 1 percent of total storage capacity), which is attributable to greater future demand for M&I water in the Lake Tahoe basin (figure 3.4).

Lake Tahoe releases are slightly (2 percent) higher in median hydrologic conditions under No Action than under current conditions because of slightly higher releases from Lake Tahoe to meet Floriston Rates from September through March. The greatest releases (about 1,500 cfs) occur in February and March in wet hydrologic conditions when a large portion of the snowpack melts rapidly. Releases from Lake Tahoe under No Action are slightly less (2 to 14 cfs, or 1 to 2.5 percent) in wet and dry hydrologic conditions than under current conditions because of greater demand in the Lake Tahoe basin. In dry hydrologic conditions, minimum releases are only available to be made from May through July. As under current conditions, when Lake Tahoe falls below its natural rim elevation, no releases can be made. Figure 3.5 shows Lake Tahoe releases.

iii. Donner Lake

Donner Lake operations and storage are the same under No Action as under current conditions (figure 3.6).

Releases from Donner Lake are nearly the same under No Action as under current conditions. A slight difference occurs from July through October, when releases are slightly less (1 to 2 cfs) under No Action than under current conditions as a result of greater future demand. See figure 3.7.

iv. Prosser Creek Reservoir

Operations model results show that Prosser Creek storage generally is the same under No Action as under current conditions from October through July in wet and median hydrologic conditions. In August and September, storage in median hydrologic conditions is about 3,000 acre-feet greater under No Action than under current conditions. In dry hydrologic conditions, storage is double that under current conditions, which reflects greater Newlands Project demand under current conditions. See figure 3.8.

Release patterns are very similar under No Action and current conditions (figure 3.9).

v. Independence Lake

Operations model results show similar storage and releases under No Action and current conditions (figures 3.10 and 3.11).

vi. Stampede Reservoir

In wet hydrologic conditions, Stampede Reservoir storage under is the same under No Action as under current conditions; storage in median hydrologic conditions storage is slightly less than under current conditions, reflecting greater future demand. Storage in dry hydrologic conditions storage is about 6,000 acre-feet greater than under current conditions and reflects Water Quality Credit Water being held. See figure 3.12.

Release patterns are very similar under No Action and current conditions (figure 3.13).

vii. Boca Reservoir

Boca Reservoir operations are the same under No Action as under current conditions, and storage and release patterns are very similar (figure 3.14).

viii. Lahontan Reservoir

Operations model results show that Lahontan Reservoir storage under No Action is 97 percent of that under current conditions, or 5,400 acre-feet less (figure 3.15).

In wet hydrologic conditions, storage is about 1 percent greater than under current conditions because lower Carson Division demand reduces the draw on storage. In median hydrologic conditions, storage is 4,400 acre-feet less (3 percent) than under current conditions. In dry hydrologic conditions, the difference is as great as 16,000 acre-feet.

Operations model results show that Lahontan Reservoir releases (made from March through November) fully meet Carson Division demands about 90 percent of the time; see table 3.13.

No releases are made, and the reservoir stores inflow, from December through the following February. In general, releases are about 3 percent lower under No Action than under current conditions because demand is less.

The differences between No Action and current conditions are a result of a combination of (1) reduced diversions under OCAP when demand is less than under current conditions, (2) greater demands in the future in the Lake Tahoe and Truckee River basins, reducing the availability of water supplies to downstream water rights holders, and (3) full exercise of Claim Nos. 1 and 2 of the *Orr Ditch* Decree.

b. LWSA

i. Total Water in Storage Upstream of Farad

Operations model results show that total reservoir storage upstream of Farad is virtually the same under LWSA as under No Action in wet, median, and dry hydrologic conditions (figure 3.3). When compared to current conditions, the difference is less than 1 percent overall.

ii. Lake Tahoe, Donner Lake, Prosser Creek Reservoir, Independence Lake, Stampede Reservoir, and Boca Reservoir

Slightly less storage is available in all hydrologic conditions under LWSA than under No Action because of the exercise of TMWA's water rights to provide 1,000 acre-feet in winter months to the increased groundwater recharge program and greater surface water demand in California. The greatest difference in storage at any reservoir is 700 acre-feet less in Stampede Reservoir in median hydrologic conditions. Figures 3.4 through 3.14 show no difference in storage and release patterns under No Action and LWSA. Differences in storage and releases between LWSA and current conditions are similar to those differences between LWSA and No Action.

iii. Lahontan Reservoir

Lahontan Reservoir storage is the same under LWSA as under No Action in wet hydrologic conditions, 100 acre-feet less in median hydrologic conditions, and 300 acre-feet less in dry hydrologic conditions (figure 3.15). Compared to current conditions, storage under LWSA is 1 percent greater in wet hydrologic conditions, 3 percent less in median hydrologic conditions, and 18 percent less in dry hydrologic conditions.

Releases are the same under LWSA as under No Action in all three hydrologic conditions and 3 percent less than under current conditions (figure 3.16).

c. TROA

Operations model results show that total storage in Truckee River reservoirs is greater under TROA than under No Action, LWSA, and current conditions. More storage is held primarily in Prosser Creek, Stampede, and Boca Reservoirs as the result of storage of Credit Waters (which includes Joint Program Fish Credit Water).

i. Total Water in Storage Upstream of Farad

Total reservoir storage upstream of Farad is about 1 percent greater in wet hydrologic conditions and 5 percent greater in median hydrologic conditions under TROA than under No Action or current conditions (figure 3.3). In dry hydrologic conditions, the total storage is much greater: 56 percent greater than under No Action and 53 percent greater than under current conditions. As a result, recreational and environmental objectives would be met frequently.

ii. Lake Tahoe

Operations model results show that Lake Tahoe storage in wet hydrologic conditions is slightly less under TROA than No Action or current conditions (1,000 acre-feet less) because Credit Water would be exchanged to another reservoir to protect it from spilling when possible. Approximately 2,000 acre-feet more is stored in median hydrologic conditions under TROA than under No Action because Credit Water is more secure in Lake Tahoe. In dry hydrologic conditions, Lake Tahoe storage is 9 percent less than under No Action and 15 percent less than under current conditions. See figure 3.4

Less storage in dry hydrologic conditions results primarily from two provisions under TROA. One provision is the exchange of Floriston Rate storage from Lake Tahoe to Stampede Reservoir and the associated increase in release from Lake Tahoe used to provide inflow to Pyramid Lake. Occasionally, this extra release from Lake Tahoe coincides with a season when Floriston Rates are supplied from Lake Tahoe storage before being supplied from Boca Reservoir storage. The operations model shows that shortly thereafter, Lake Tahoe storage drops so low that minimum releases cannot be maintained. In such case, the Lake Tahoe release (for exchange with Stampede Reservoir storage) under TROA is greater than the release under No Action. Thus, storage is less under TROA than under No Action.

The other provision under TROA is that when Lake Tahoe is the first reservoir used to supply Floriston Rates, releases are greater under TROA than under No Action because Credit Water is stored in Lake Tahoe. Therefore, releases of Floriston Rate water are higher under TROA than under No Action, and, consequently, less Tahoe Floriston Rate Water is stored. When a subsequent month has enough inflow to reduce Floriston Rate Water demand on Lake Tahoe, Credit Water is released from storage. Then, in subsequent months (as Lake Tahoe drops to its rim elevation), storage and releases are less than under No Action.

Lake Tahoe releases are slightly higher (2 percent) under TROA than under No Action and current conditions in wet and median hydrologic conditions. In median hydrologic conditions, higher releases from April through July offset lower releases the remainder of the year. In dry hydrologic conditions, Lake Tahoe releases are 2.5 percent lower under TROA than under No Action and 5 percent lower than under current conditions. See figure 3.5.

Operations model results show that October through January releases from Lake Tahoe are generally lower under TROA than under No Action or current conditions. The greatest difference occurs in October; the difference is less in each succeeding month. In October, establishment of credit storage in Lake Tahoe under TROA results in lower releases and, during October, Floriston Rate demand is partially supplied by releases from Stampede Reservoir. These releases from Stampede Reservoir in October result from previous (during the season) exchange of Lake Tahoe Floriston Rate storage into Stampede Reservoir. Operations model results show that enhanced minimum releases of 75 cfs are provided about 20 percent of the time under TROA.

February through March releases are about the same under TROA as under either No Action or current conditions. Under TROA, flows are maintained at 75 cfs about 10 percent more often than under No Action or current conditions because of the opportunity to make additional releases using Credit Water stored in Lake Tahoe. These additional releases are made when the release can be matched by an accumulation of storage in another reservoir. Under TROA, releases are less than the minimum of 50 cfs slightly more often because of a few cases when Lake Tahoe storage is less.

April through July releases in wet and median hydrologic conditions are higher under TROA than under No Action or current conditions. Operations model results show these higher releases occur most dramatically in median hydrologic conditions, primarily because Credit Water is released to (1) support spawning of cui-ui, (2) supply the 75 cfs enhanced minimum release, and (3) exchange Floriston Rate storage from Lake Tahoe into Stampede Reservoir. In wet and median hydrologic conditions, preferred flows for enhancing recreational and environmental uses are met. Note that this release of Credit Water from Lake Tahoe and the exchange into Stampede Reservoir reduces the release from Stampede Reservoir.

August through September releases are lower under TROA than under No Action or current conditions in all three hydrologic conditions. These lower releases are primarily related to (1) lower releases associated with establishment of Credit Water storage under TROA and (2) lower Lake Tahoe releases of Floriston Rate Water because, under TROA, this is the period when Stampede Reservoir begins releasing the Lake Tahoe Floriston Rate Water exchanged to Stampede Reservoir during the spring months. Between 10 to 15 percent of the time, the enhanced minimum release of 75 cfs is provided under TROA compared to the 70 cfs minimum release under the other alternatives.

iii. Donner Lake

From July through August, Donner Lake storage is slightly less (200-400 acre-feet) under TROA than under No Action or current conditions in wet and median hydrologic conditions. This difference results from higher minimum release requirements under TROA and greater opportunity for using Donner Lake water under TROA.

In September, storage is greater in median (1,600 acre-feet more) and dry (800 acre-feet more) hydrologic conditions under TROA than under current conditions because of balancing instream flows from Donner Lake in September and October. In other months, storage is the same under TROA as under No Action and current conditions. Average annual storage in wet, median, and dry hydrologic conditions is the same under TROA, No Action, and current conditions. See figure 3.6

October through the following January releases tend to be greater under TROA than under No Action or current conditions. This difference occurs primarily in October, when releases are made from Donner Lake to provide an exchange that establishes TMWA M&I Credit Water in other Truckee River reservoirs.

February through March releases are the same under TROA, No Action, and current conditions. Releases from mid-November through early April are unregulated.

April through July releases are higher approximately 35 percent of the time under TROA because of higher flow targets.

August through September releases are higher in wet, median, and dry hydrologic conditions under TROA than under No Action or current conditions because of higher flow targets under TROA. Operations model results show that releases in September under TROA are almost always equal to the preferred release of 10 cfs. See figure 3.7.

iv. Prosser Creek Reservoir

Prosser Creek Reservoir storage is greater under TROA than under No Action or current conditions because TROA includes numerous categories of water storage and considers recreation objectives. The combination of storing Credit Waters and Project Water to help achieve recreational pool targets provides greater August storage than any other alternative. See figure 3.8.

In wet hydrologic conditions, storage is essentially the same under TROA as under No Action and current conditions.

In median hydrologic conditions, from July through September, storage is up to 10,000 acre-feet greater (55 percent more) under TROA than under No Action and up to 13,000 acre-feet greater (double) than under current conditions. Overall, storage is 13 percent greater under TROA than under No Action and 17 percent greater than under current conditions.

In dry hydrologic conditions, storage is 60 percent greater under TROA than under No Action and 180 percent greater than under current conditions. This dramatically greater storage would provide substantial benefits. Storage of Credit Waters would provide the opportunity to meet demands and to enhance recreation by keeping the reservoir much higher. Operations model results show that the recreational pool target of 19,000 acre-feet is achieved 70 percent of the time.

October through January releases from Prosser Creek Reservoir generally are higher under TROA than under No Action or current conditions. Releases are higher because storage in August is greater under TROA, and Prosser Creek Reservoir storage in excess of 9,800 acre-feet must be released by the end of October. In median and dry hydrologic conditions, releases are at least 50 percent higher under TROA than under No Action or current conditions.

February through March releases are similar under TROA, No Action, and current conditions because of flood control operations.

April through July releases tend to be much lower under TROA than under No Action and current conditions because Credit Waters and Water Quality Water are accumulating, resulting in lower releases. In wet, median, and dry hydrologic conditions, releases are lower under TROA than under the other alternatives because of operations to meet recreational pool targets.

August through September releases are higher under TROA than under No Action or current conditions. August through September releases are patterned after the California Guidelines' preferred minimum releases and are more uniform under TROA than under No Action or current conditions. August releases are less, and September releases are greater under TROA than under No Action or current conditions. See figure 3.9.

v. Independence Lake

Independence Lake storage is slightly less in wet, median and dry hydrologic conditions under TROA than under No Action or current conditions primarily because under TROA, releases are made to satisfy much greater minimum streamflows and for re-storage as TMWA M&I Credit Water in a downstream reservoir (figure 3.10.) Operations model results show that this release for re-storage tends to be greater in August under TROA.

May through September releases in dry hydrologic conditions are much higher under TROA than under No Action or current conditions.

October through January releases are about the same under TROA, No Action, and current conditions. The lowest flows tend to be slightly higher under TROA because of higher minimum flow targets. Releases during this period under TROA also are higher because more water is withdrawn from Independence Reservoir for re-storage in other reservoirs.

February through March releases also are about the same under TROA as under No Action and current conditions, although releases under TROA are slightly higher because of higher minimum releases.

April through July releases are about the same under TROA as under No Action and current conditions. Under TROA, releases are sometimes higher because of higher streamflow objectives.

August through September releases are almost always higher under TROA than under No Action or current conditions. For example, releases under TROA in August and September are 10-12 cfs about 70 percent of the time, while releases are this high only about 10 percent of the time under No Action and current conditions. Under TROA, August through September releases are patterned after the California Guidelines and are more uniform than under the No Action or current conditions. As a result, August releases tend to be greater and September releases tend to be less under TROA than under the other alternatives. See figure 3.11.

vi. Stampede Reservoir

Operations model results show that Stampede Reservoir storage is greater under TROA than under No Action or current conditions in wet, median, and dry hydrologic conditions (figure 3.12). When storage is greater than 210,000 acre-feet, storage is similar under TROA, No Action, and current conditions. When storage is less than 210,000 acre-feet (about 75 percent of the time), storage is generally 30,000 to 60,000 acre-feet greater under TROA than under No Action and current conditions. In dry hydrologic conditions, storage is as much as 79,000 acre-feet under TROA, compared to only 28,000 acre-feet under No Action and 54,000 acre-feet under current conditions. Minimum storage in Stampede Reservoir under TROA is about 18,700 acre-feet, compared to about 4,600 acre-feet under No Action and 5,900 acre-feet under current conditions.

Operations model results show that Stampede Reservoir storage is greater under TROA because of Credit Water and exchange of Lake Tahoe Floriston Rate Water. Release of Lake Tahoe Floriston Rate Water extends from August into October. Under TROA, Stampede Reservoir is assumed to have the right to store up to 226,500 acre-feet a year.

Under TROA, October through January releases provide more frequent and more sustained releases at the rate of the enhanced minimum release (45 cfs). In addition, operations model results show that TROA provides greater releases to supply Floriston Rate Water using the Lake Tahoe Floriston Rate Water exchanged into Stampede Reservoir and provides greater release or spill during October to pull the storage down to the flood control pool. Under TROA, operations model results show that reservoir storage must be released or spilled in more years to provide the required flood control space.

February through March releases generally are lower under TROA than under No Action or current conditions because Credit Waters are accumulating at this time. About 5 percent of the time, releases are greater than under the other alternatives as the result of Credit Water storage causing spills.

April through July releases under TROA differ from those under other alternatives because of the maintenance of 45 cfs enhanced minimum release and use of an exchange with Lake Tahoe Floriston Rate Water, which limits release to about 125 cfs, the preferred release. As from February through March, greater spills occur about 5 percent of the time.

August through September releases are the same or greater in all hydrologic conditions under TROA than under No Action or current conditions due to the following operations:

- Maintain the 45 cfs enhanced minimum flow.
- Release exchanged Lake Tahoe Floriston Rate Water
- Provide flood control space by the end of October.

See figure 3.13.

vii. Boca Reservoir

Most of the time, Boca Reservoir storage is greater under TROA than under No Action or current conditions (figures 3.14). Storage of Credit Water and Project Water, as well as water released from Stampede Reservoir to meet enhanced and preferred minimum releases, can be re-stored in Boca Reservoir. As discussed previously, releases from Boca Reservoir are not necessarily indicative of hydrologic conditions and were not analyzed.

viii. Lahontan Reservoir

Because water rights are more fully exercised by water rights holders to create Credit Water, operations model results show that Lahontan Reservoir storage is slightly less under TROA than under No Action. Storage is less under TROA than under current conditions because of less Carson Division demands in the future. Carson Division demands are met in wet, median, and dry hydrologic conditions. ??? is offset by decreased depletions in Truckee Meadows caused by purchase of additional agricultural water rights. See figures 3.15 and 3.16.

D. Flows

1. Method of Analysis and Operations Model Input

Model operations and inputs are the same as for "Reservoirs." Monthly average flows (in cfs) at Farad, Vista, and Nixon, generated from the operations model, were compared in wet, median, and dry hydrologic conditions.

2. Model Results

Monthly average flows in wet, median, and dry hydrologic conditions under current conditions, No Action, LWSA, and TROA at each location are presented in the following figures.

Location	Figure
Truckee River at Farad, California	3.17
Truckee River at Vista, Nevada	3.18
Truckee River at Nixon, Nevada	3.19

a. Current Conditions

Table 3.12 presents average annual flow in wet, median, and dry hydrologic conditions.

Table 3.12.—Average annual flow in wet, median, and dry hydrologic conditions at Farad, Vista, and Nixon

Location	Current	No Action	LWSA	TROA
Farad				
Wet	1,424	1,412	1,411	1,450
Median	653	641	641	634
Dry	428	423	423	420
Vista				
Wet	1,456	1,427	1,425	1,480
Median	638	613	611	626
Dry	397	380	379	390
Nixon				
Wet	1,410	1,396	1,394	1,452
Median	579	563	561	569
Dry	146	159	159	162

The Water Resources Appendix shows modeled average monthly flows at all locations (in tables) as well as monthly, seasonal, and annual exceedence frequency curves.

i. Truckee River at Farad

Flow at Farad represents the combined releases from Lake Tahoe, Donner Lake, Martis Creek Reservoir, Prosser Creek Reservoir, and Boca Reservoir added to the uncontrolled runoff of the Truckee River between Lake Tahoe and Farad. This reach indicates the quantity of water available for use in Nevada.

Operations model results show that Floriston Rates are achieved in all months in wet and median hydrologic conditions under current conditions. In dry hydrologic conditions, Floriston Rates are not achieved from August through February. In these months, flow represents the natural runoff, because the reservoirs have little or no stored water available for release. Maximum flow is 3,323 cfs in May in wet hydrologic conditions; minimum flow is 162 cfs in November in dry hydrologic conditions. See figure 3.17.

ii. Truckee River at Vista

Flow at Vista indicates the quantity of water available to Pyramid Lake and the Truckee Canal. Flows at Vista are very similar to flows at Farad (figure 3.18). In wet hydrologic conditions, flow at Vista is generally higher than at Farad because of the addition of Steamboat Creek flows. In median and dry hydrologic conditions, flow is less than at Farad from May through October because of the exercise of agricultural and M&I water rights. Flow is greater than at Farad from November through the following April. Average annual

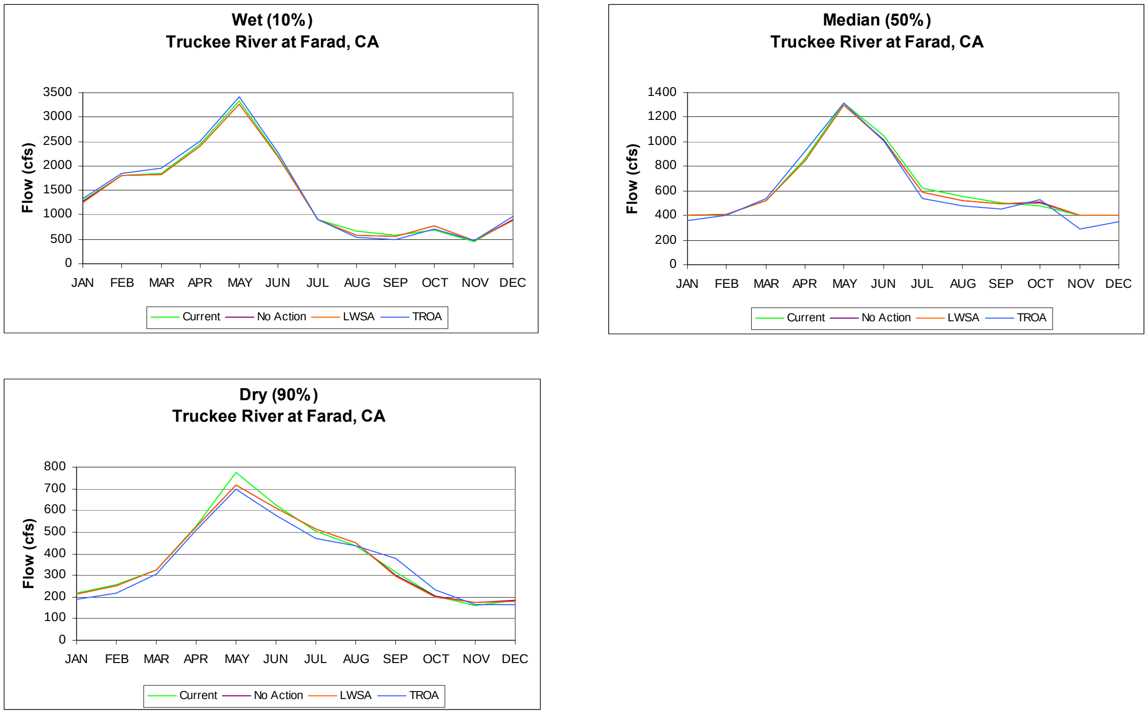


Figure 3.17.—Modeled Truckee River flow at Farad.

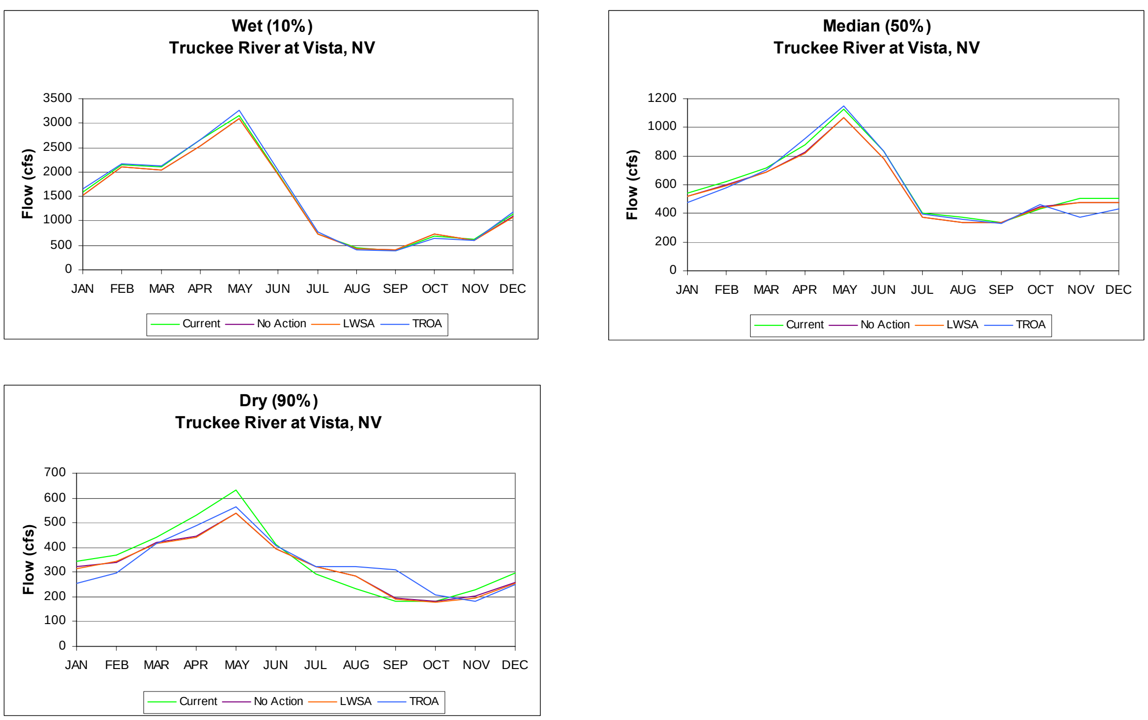
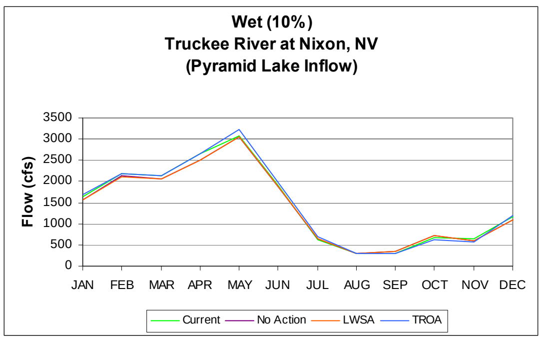


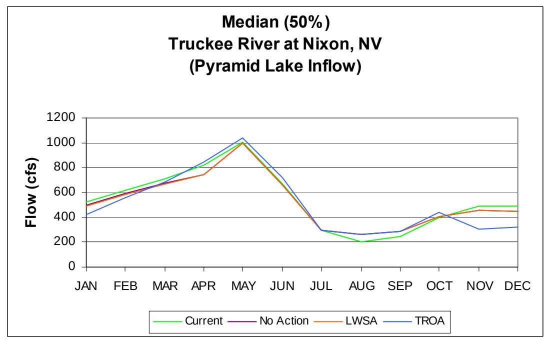
Figure 3.18.—Modeled Truckee River flow at Vista.

flow at Vista is the same as at Farad. Vista flow is 93 percent of Farad flow in dry hydrologic conditions, but average 102 percent and 97 percent of this flow in wet and median hydrologic conditions, respectively. Maximum flow in wet hydrologic conditions is 3,158 cfs in May; minimum monthly flow in dry hydrologic conditions is 181 cfs in September.

iii. Truckee River at Nixon

Flow at Nixon represents inflow to Pyramid Lake. Operations model results show that the flow pattern at Nixon is similar to that at Vista, but quantity is reduced by diversions to the Truckee Canal and agricultural uses in the lower Truckee River during the irrigation season from April through September (figure 3.19). Flow at Nixon is 37 percent of that at Vista in dry hydrologic conditions, but averages 97 percent and 91 percent of that flow in wet and median hydrologic conditions, respectively.





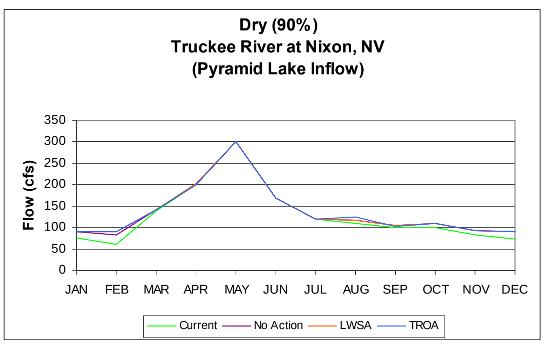


Figure 3.19.—Modeled Truckee River flow at Nixon.

In general, flows increase from November through the following May. Increases from October through February result primarily from precipitation and runoff. Increases from March through May are caused by a combination of uncontrolled spring runoff and Stampede Reservoir releases for Pyramid Lake fishes. Flows decrease from June through September as the result of a decrease in natural flow and, to some extent, reservoir releases. The Pyramid Lake inflow target decreases in these months under the six-flow regime operation, so there is a tendency to reduce releases from Stampede and Prosser Creek Reservoirs. Maximum flow is 3,089 cfs in May in wet hydrologic conditions; minimum flow is 62 cfs in February in dry hydrologic conditions.

See "Biological Resources" for analysis and discussion of the six-flow regime effects on Pyramid Lake inflow.

3. Evaluation of Effects

a. No Action

Comparison of average seasonal flows at various locations in the Truckee River basin indicates the availability of water to meet flow targets and support environmental and recreational uses. As shown in table 3.13, in general, flows are lower under No Action than under current conditions because of the greater future demands in California and Nevada.

i. Truckee River at Farad

Operations model results show that Floriston Rates are achieved in all months in wet and median hydrologic conditions under No Action. In dry hydrologic conditions, Floriston Rates are not achieved from August through the following February. In these months, natural runoff of the basin is supplemented with releases to meet flow regime and water quality targets.

Lake Tahoe is at or near its natural rim, so no water is available to be released for Floriston Rates. See figure 3.17.

Maximum flow is 3,269 cfs in May in wet hydrologic conditions, and minimum flow is 175 cfs in November in dry hydrologic conditions, or 8 percent higher than under current conditions, because of Water Quality Credit Water releases. Average annual flow is about 99 percent of that under current conditions.

ii. Truckee River at Vista

In dry hydrologic conditions, operations model results show that Truckee River flow at Vista is somewhat higher (more than 13 cfs) under No Action than under current conditions from July through September because Water Quality Water is released to improve water quality in the river from Truckee Meadows to Pyramid Lake. Under current conditions, much of the river flow is delivered to the Truckee Canal, while under No Action, any Water Quality Water would be required to flow to Pyramid Lake. See figure 3.18.

Maximum flow is 3,092 cfs in May in wet hydrologic conditions, and minimum flow is 181 cfs in October in dry hydrologic conditions, or 9 percent higher than under current conditions, because of Water Quality Credit Water releases. Average annual flow is about 98 percent of that under current conditions.

iii. Truckee River at Nixon

Operations model results show that Truckee River flow at Nixon is somewhat higher under No Action than under current conditions in dry hydrologic conditions from June through

September because of Water Quality Water releases. See figure 3.19. Maximum flow is 3,055 cfs in May in wet hydrologic conditions. Minimum flow is 83 cfs in February in dry hydrologic conditions, or 9 percent higher than under current conditions, because of Water Quality Credit Water releases. Average annual flow is about 98 percent of that under current conditions.

See "Biological Resources" for analysis and discussion of the six-flow regime effects on Pyramid Lake inflow.

c. LWSA

Operations model results show that flows at Farad, Vista, and Nixon in wet, median, and dry hydrologic conditions are about the same under LWSA as under No Action. See figures 3.17 through 3.19.

d. TROA

In general, operations model results show that higher flows occur in dry hydrologic conditions and lower flows occur in wet hydrologic conditions under TROA than under current conditions or No Action.

i. Truckee River at Farad

The flow pattern in the Truckee River at Farad is essentially the same under TROA, No Action, and current conditions (figure 3.17). Flow at Farad is 3 percent higher in wet hydrologic conditions and 2 percent lower in median and wet hydrologic conditions under TROA than under No Action. Flow is 2 percent higher in wet hydrologic conditions and 2 percent lower in median and dry hydrologic conditions under TROA than under current conditions. Higher flows in wet hydrologic conditions are caused by greater spills from February through June under TROA, and lower flows in median and wet hydrologic conditions are caused by storage of Credit Water from October through March. Average annual flow at Farad under TROA is 99 percent of that under No Action and 98 percent of that under current conditions.

Maximum flow is 3,409 cfs in May in wet hydrologic conditions, or 4 percent higher than under No Action and 3 percent higher than under current conditions. Minimum flow is 165 cfs in November in dry hydrologic conditions.

ii. Truckee River at Vista

Generally, Truckee River flow at Vista under TROA is 102 percent of that under No Action and 99 percent of that under current conditions. See figure 3.19. Maximum flow is 3,270 cfs in wet hydrologic conditions, or 7 percent higher than under No Action and 4 percent higher than under current conditions. Minimum flow in dry hydrologic conditions is 1 percent higher under TROA than under No Action or current conditions.

October through the following January flows generally are slightly lower under TROA than under No Action or current conditions, primarily because of the accumulation of Credit Waters.

February through March flows under TROA, No Action, and current conditions follow the same pattern as October through January flows; flows under TROA generally are lower in median and dry hydrologic conditions because of the accumulation of Credit Waters. In wet hydrologic conditions, flow is greater under TROA because more Credit Water is in storage, which causes spills to occur more frequently.

In wet hydrologic conditions, April through July flows are higher under TROA than under either No Action or current conditions because more Credit Water is in storage, which causes spills to occur more frequently. Flow is generally are lower under TROA than under current conditions in median hydrologic conditions because of lower diversions. Flow is higher in dry hydrologic conditions because Water Quality Water is released in July under the alternatives. In median and dry hydrologic conditions, flow is about the same under TROA as under No Action.

August through September flows are slightly lower 50 percent of the time under TROA than under No Action and current conditions in higher flow situations, which occur in years when there is more water in the Truckee River than is required to provide adequate water quality flow. Under No Action and current conditions, there is no means for storing this surplus water. Under No Action, water quality storage can only occur if a release of Federal water can be reduced, and the water in the Truckee River can be replaced by a reduction in diversion. Thus, under No Action, the surplus water remains in the Truckee River and flows into Pyramid Lake. Under TROA, such surplus water frequently can be stored in Truckee River reservoirs.

iii. Truckee River at Nixon

Average annual flow in the Truckee River at Nixon is 2 percent and 1 percent higher under TROA than under No Action and current conditions, respectively. In wet hydrologic conditions, flow is 4 percent higher under TROA than under No Action and 3 percent higher than under current conditions. In median hydrologic conditions, flow is 1 percent higher under TROA than under No Action and 2 percent lower than under current conditions. Inflow to Pyramid Lake under TROA is 2 percent higher than under No Action and 11 percent higher than under current conditions. See figure 3.19.

Maximum flow is 3,231 cfs in May in wet hydrologic conditions, and minimum flow is 90 cfs in February in dry hydrologic conditions, or 8 percent higher than under No Action and 45 percent higher than under current conditions. These higher flows are the result of the increased opportunity to release Water Quality Credit Water.

October through the following January flow patterns at Nixon are similar to those at Vista. Except in wet months, flows under TROA are generally less than or equal to flows under No Action and current conditions. The maximum inflow target from October through January is 160 cfs.

When Pyramid Lake inflow is between about 160 cfs and 700 cfs, TROA is likely to have lower inflow than other alternatives because of storage of Credit Water.

February through March flows are slightly greater in low-flow conditions under TROA than under No Action or current conditions because of greater supply under TROA with which to supplement other flows. Flows are slightly lower under TROA in median hydrologic conditions because of the opportunity to store surplus Truckee River flow.

April through July flows are nearly the same under all alternatives. Inflow tends to be slightly higher under during extreme low flows under TROA because more water available from reservoir storage. Also, inflow tends to be higher under TROA in high-flow periods because of greater reservoir spills.

August through September flows are greater under TROA than under either No Action or current conditions.

E. Exercise of Water Rights to Meet Demand

1. Method of Analysis

Currently, the water supply available for diversion does not satisfy water rights demands in every year. Variable water rights acquisition and transfers in the future make it difficult to directly compare the effectiveness of future operations in satisfying the exercise of water rights. Therefore, operations model results were analyzed to determine the percentage of water rights that were met in the "minimum supply year." For this analysis, the minimum supply year (or minimum annual supply) is defined as the year with the least supply to meet water rights over the 100-year period of simulation. Agricultural demand in Truckee Meadows, the Truckee and Carson Divisions of the Newlands Project, and in the lower Truckee River basin (including the Pyramid Tribe) were analyzed. Additionally, M&I demand in the Lake Tahoe basin, Truckee River basin in California and Nevada, and Truckee Meadows were analyzed.

2. Model Results

Table 3.13 presents operations model results for Nevada agricultural and M&I minimum annual water supply available and the percentage of water rights demands met by the exercise of water rights in the minimum supply year. Supplies and demands in California are discussed in the narrative.

a. Current Conditions

Operations model results show that under current conditions, the exercise of water rights cannot meet current agricultural and M&I demands in all years. Nevada agricultural and M&I demands in the Truckee River basin are met primarily from surface water sources and are subject to the variability of the surface water supply.

Table 3.13.—Annual demand in Nevada and annual average and minimum agricultural and and M&I supplies (acre-feet)

	Current conditions	No Action	LWSA	TROA
Truckee Meadows				
Agriculture				
Annual water rights demand	40,770	21,500	21,500	4,860
Average supply	39,170	20,720	20,720	4,690
Minimum annual supply	8,710	6,510	6,520	1,640
Demand met in minimum supply year	21.4%	30.3%	30.3%	33.7%
M&I				
Water rights demand	83,140	119,000	119,000	119,000
Average supply	83,140	118,410	118,670	118,260
Minimum supply	83,140	108,420	112,690	113,720
Demand met in minimum supply year	100%	91.1%	94.7%	95.6%
Newlands Project – Truckee Division				
Agriculture				
Water rights demand	18,520	0	0	0
Average supply	18,070			
Minimum supply	9,530	0	0	0
Demand met in minimum supply year	51.5%	N/A	N/A	N/A
Fernley M&I				
Water rights demand	[1]0	[2]6,800	[2]6,800	[2]6,800
Average supply	0	6,600	6,600	6,600
Minimum supply	0	3,600	3,600	3,600
Demand met in minimum supply year	0	52.9%	52.9%	52.9%
Newlands Project – Carson Division				
Agriculture				
Water rights demand	275,720	268,870	268,870	268,870
Average supply	269,410	260,720	260,610	260,690
Minimum supply	130,070	110,580	109,760	110,790
Demand met in minimum supply year	47.2%	41.1%	40.8%	41.2%
Lower Truckee River (including Pyramid Tribe)				
Agriculture				
Water rights demand	12,040	17,900	17,900	17,900
Average supply	12,040	17,900	17,900	17,900
Minimum supply	12,040	17,900	17,900	17,900
Demand met in minimum supply year	100%	100%	100%	100%
M&I				
Water rights demand	0	16,380	16,380	16,380
Average supply	0	16,380	16,380	16,380
Minimum supply	0	16,380	16,380	16,380
Demand met in minimum supply year	N/A	100%	100%	100%

[1] Current demand of 3,280 acre-feet supplied by local groundwater sources.

[2] Transfer of 6,800 acre-feet of Truckee Division agricultural water rights would provide a portion of the future demand of 29,500 acre-feet; supply for the additional 22,700 acre-feet has not been identified and was not modeled.

i. Agriculture

Truckee Meadows and Newlands Project agricultural demands are met by surface water supplies; supplies are not adequate in drought years. In the minimum supply year, 21.4 percent of demand is met in Truckee Meadows; 51.5 percent of demand is met in the Truckee Division; and 47.2 percent of demand is met in the Carson Division.

Lower Truckee River demands are fully met because of the high priority of the Pyramid Tribe's water rights.

ii. M&I

M&I demands in the Lake Tahoe basin in California and Nevada are met by surface water and groundwater. M&I demands in the Truckee River basin in California are met primarily by groundwater and are assumed to be met in all years. M&I demands in the Truckee River basin in Nevada are met primarily by surface water and are subject to the variability of the surface water supply.

Truckee Meadows M&I supply is very reliable, because of TMWA's ability to supplement the surface water supply with groundwater supplies and Private Water stored in Donner and Independence Lakes. Under current conditions, supplies are adequate to meet demands, partially because of TMWA's water rights acquisition program to secure supplies for the future. TMWA has acquired more water rights than it currently needs to supply demands.

3. Evaluation of Effects

Note that while the operations model can calculate the small differences in supply and demand shown in the following analysis, they are likely not measurable in real-time operation.

a. No Action

i. Agriculture

(a) Truckee Meadows

Operations model results show that in the minimum supply year, 30.3 percent of agricultural demand in Truckee Meadows is met under No Action, compared to 21.4 percent under current conditions because fewer water rights would need to be served under No Action.

(b) Truckee Division

Under No Action, the operations model assumes that all Truckee Division water rights have been acquired for Fernley M&I and water quality improvement purposes.

(c) Carson Division

In the minimum supply year, 41.1 percent of the agricultural demand in the Carson Division is met, or 6.2 percent less than under current conditions, primarily because of future development in California and full exercise of the Pyramid Tribe's Truckee River water rights.

Newlands Project supplies from the Truckee River are less under No Action than under current conditions for several reasons, including the following:

- Carson Division demand is less as a result of WRAP.
- California and Nevada water use in the Lake Tahoe basin is greater, thus less water is available to Truckee River users.
- California water use from the Truckee River basin is greater, thus less water is available to Nevada.
- Use of *Orr Ditch* Decree water rights (including Claim Nos. 1 and 2) is greater, thus the proportionate supply to lower water rights is less.
- Use of reservoir storage in Independence and Donner Lakes is greater, thus less water is available for direct diversion from the Truckee River.

(d) Lower Truckee River basin

Agricultural demands in the lower Truckee River basin are met 100 percent of the time under both current conditions and No Action. The Pyramid Tribe's most senior water right priority ensures that its agricultural demands are satisfied.

ii. M&I

(a) Truckee River Basin in California

The average annual surface water supply is sufficient to satisfy the M&I demand in the Truckee River basin in California under current conditions. Under No Action, the average annual surface water supply is sufficient to meet M&I demand because California has a high priority to divert water from surface flows for M&I purposes.

(b) Lake Tahoe Basin

Because M&I demands for surface water from the Lake Tahoe basin in California and Nevada have high priorities, sufficient supplies are always available under current conditions, as well as under No Action.

(c) Truckee Meadows

Under current conditions, the average annual surface water supply is sufficient to meet demand. As discussed previously, M&I water demand is projected to be greater in the future. The M&I surface water supply also is greater under No Action than under current conditions because agricultural water rights would be transferred to M&I use and TMWA's existing water rights would be more fully exercised under No Action. Under No Action, average annual water supply is not sufficient in all years to satisfy the greater M&I demand. In the minimum supply year, 91.9 percent of the demand is met. Conservation measures would be implemented to reduce demand in these years. This decrease in supply is caused primarily by future development in California and greater demand in Truckee Meadows.

b. LWSA

i. Agriculture

Operations model results show that Truckee Meadows and lower Truckee River basin agricultural demands are met to the same degree under LWSA and No Action. The differences noted between current conditions and No Action are the same.

The Carson Division receives slightly less water (100 acre-feet) under LWSA than under No Action, and the minimum year supply is also slightly less (800 acre-feet, or 0.3 percent less). This difference is caused by greater exercise of TMWA water rights for the increased groundwater recharge program under LWSA. The minimum year supply is 14 percent less than under current conditions.

ii. M&I

The M&I water supply for the Truckee River basin in California and the Lake Tahoe basin is the same under LWSA and No Action. Differences between LWSA and current conditions are the same as between No Action and current conditions. Under LWSA, a greater amount of surface water is diverted, but this is offset by decreased groundwater use for no net change in California demands.

Truckee Meadows M&I demand is the same under LWSA as under No Action. However, TMWA would exercise its water rights to provide and additional 1,000 acre-feet in winter months for an increased groundwater recharge program. Under LWSA, 300 acre-feet of average supply is provided to the groundwater recharge program in addition to the supply under No Action. In the minimum supply year, 94.7 percent of the demand is met, compared to 91.9 percent under No Action; thus, conservation measures would be implemented to a lesser degree than under No Action. As previously discussed, current conditions demands are less and are met in all years.

c. TROA

i. Agriculture

(a) Truckee Meadows

Operations model results show that 33.7 percent of the agricultural demand in Truckee Meadows is met in the minimum supply year under TROA, compared to 30.3 percent under No Action and 21.4 percent under current conditions.

(b) Carson Division

Agricultural demand in the Carson Division is met about the same under TROA as under No Action during the most severe drought. Average annual supply is slightly less (30 acre-feet) under TROA than under No Action. Timing of Truckee River supplies results in a minimal decrease in diversions to the Newlands Project in some years. A total of 41.2 percent of the demand is met in the minimum supply year, compared to 41.1 percent under No Action, (about 200 acre-feet more) and 47.2 percent under current conditions.

(c) Lower Truckee River Basin

Agricultural demands in the lower Truckee River basin are met 100 percent of the time under TROA. The Pyramid Tribe’s most senior water priority ensures that its agricultural water demands are satisfied.

ii. M&I

(a) Truckee River Basin in California

The average annual surface water supply is sufficient to satisfy current and future California M&I demand for surface water in the Truckee River basin.

(b) Lake Tahoe Basin

Sufficient water supplies are available under TROA, No Action, and current conditions to meet M&I demand in the Lake Tahoe basin in California and Nevada.

(c) Truckee Meadows

Under TROA, the average annual supply is slightly less than under No Action because of the requirement for conservation and demand reduction when a drought condition exists. This requirement results in reduced demand in some years when there is sufficient supply to the meet normal demand to ensure supplies in extreme drought conditions. Under TROA, 95.6 percent of the demand is met in the minimum supply year, compared to 91.9 percent under No Action. Although the average annual supply is less, the minimum year supply is 5,300 acre-feet greater. TROA would allow for a trade-off between average annual supply and minimum supply. The greater minimum year supply outweighs the artificial decrease in average annual supply. As previously discussed, current conditions demands are less and are met in all years.

F. Optional Scenarios

TROA was modeled using the demands, credit storage options, and distribution of water rights "most likely" to occur in the future (2033) based on the Draft Agreement. Two additional scenarios were analyzed to provide perspective on the effects of potential future Truckee River operations under TROA. Analyses were performed for the following: (1) Fernley Municipal Credit Water (Fernley) and (2) Donner Storage Right (Donner-TMWA). Under the Fernley scenario, it was assumed that the city of Fernley would store a portion of the water associated with surface water rights acquired from the Truckee Division. Under the Donner-TMWA scenario, it was assumed that TMWA would acquire TCID's portion of the Donner Lake storage right to increase TMWA's M&I water supply

1. Method of Analysis

The same method of analysis was used for the optional scenarios as for the alternatives. Operations model input assumptions were the same as for TROA, except for the following:

> **Fernley Scenario:** The operations model assumes that of the 6,800 acre-feet of acquired surface water rights, 5,100 acre-feet would be used to meet M&I demands in normal years; the remaining 1,700 acre-feet would be stored as Fernley Municipal Credit Water up to a total of 10,000 acre-feet. Releases would be made to meet Fernley M&I demands when the exercise of Fernley surface water rights could not meet the 5,100 acre-feet of M&I demand.
>
> **Donner-TMWA Scenario**: Donner Lake would be operated to meet TMWA's M&I demand from total reservoir storage.

2. Model Results

Results for each scenario were compared to the results for the analysis of TROA. Figures 3.20, 3.21, 3.22 show reservoir storage and releases under the Fernley scenario in wet, median, and dry hydrologic conditions. Figures 3.23, 3.24, and 3.25 show reservoir storage and releases under the Donner-TMWA scenario in wet, median, and dry hydrologic conditions.

3. Evaluation of Effects

a. Fernley Scenario

Operations model results show that total reservoir storage in Truckee River reservoirs is slightly greater under this scenario because of the storage of Fernley M&I Credit Water (figures 3.20, 3.21, and 3.22), as follows:

Wet hydrologic conditions	220 acre-feet
Median hydrologic conditions	580 acre-feet
Dry hydrologic conditions	840 acre-feet

In general, operations model results show very little difference between this scenario and TROA in wet and median hydrologic conditions. In dry hydrologic conditions, storage in all reservoirs, except Donner Lake, is slightly greater under the Fernley scenario than under TROA. Greater Independence Lake and Prosser Creek Reservoir storage is the result of slightly lower releases. Stampede Reservoir releases are slightly higher and may account for the greater storage in Boca Reservoir. Greater Lake Tahoe and Stampede Reservoir storage in dry hydrologic conditions is the result of storage of Fernley M&I Credit Water. In wet hydrologic conditions, the slightly greater total reservoir storage is held in Lake Tahoe. The additional storage is held in Stampede Reservoir from October through November and in Lake Tahoe the remainder of the year in median hydrologic conditions.

Operations model results show that average annual flow at Farad and Vista is the same under this scenario as under TROA. Flow at Nixon is greater under this scenario because some of the unused portion of Fernley's M&I stored water is either spilled or converted to Fish Credit Water and flows to Pyramid Lake. The remaining amount normally needed for delivery is left in the Truckee River and flows to Pyramid Lake. The flow at Nixon under the Fernley scenario is 694 cfs, 2 cfs greater than under TROA, resulting in an additional 1,550 acre-feet per year of inflow to Pyramid Lake.

Agricultural and M&I demands are met to the same degree under this scenario and TROA, except for Carson Division demands. Under the Fernley scenario, the Truckee Canal diverts slightly more water to Lahontan Reservoir and reduces the average annual shortage by 10 acre-feet. This is caused by a difference in the timing of Truckee River flow.

Overall, reservoir storage is greater in dry hydrologic conditions and inflow to Pyramid Lake is greater under the Fernley scenario than under TROA. No adverse effects were identified.

b. Donner-TMWA Scenario

Operations model results show that total reservoir storage in Truckee River reservoirs is slightly less in wet and median hydrologic conditions under the Donner-TMWA scenario than under TROA because Truckee River diversions to the Newlands Project are slightly

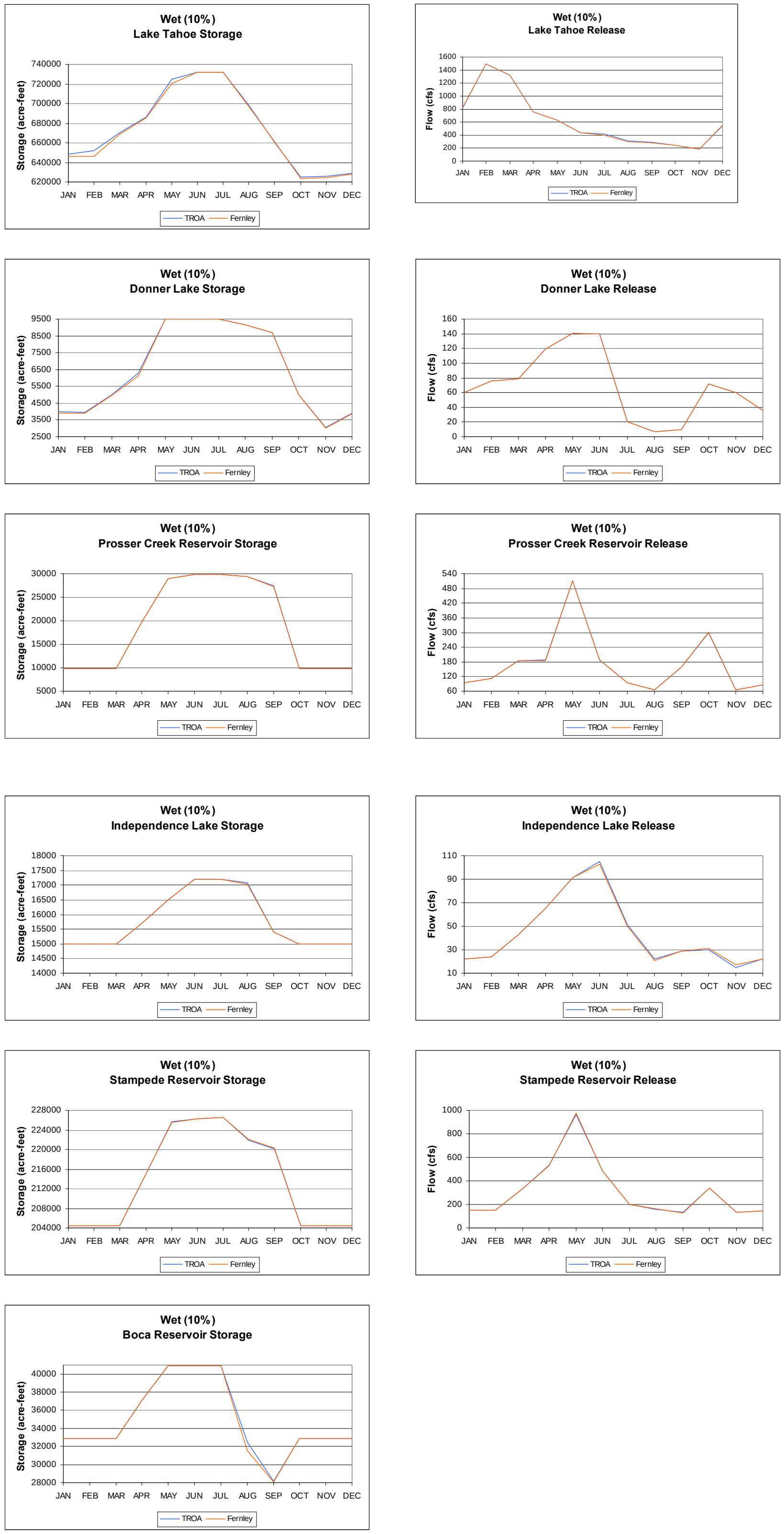


Figure 3.20.—Fernley scenario: Modeled reservoir storage and releases in wet hydrologic conditions.

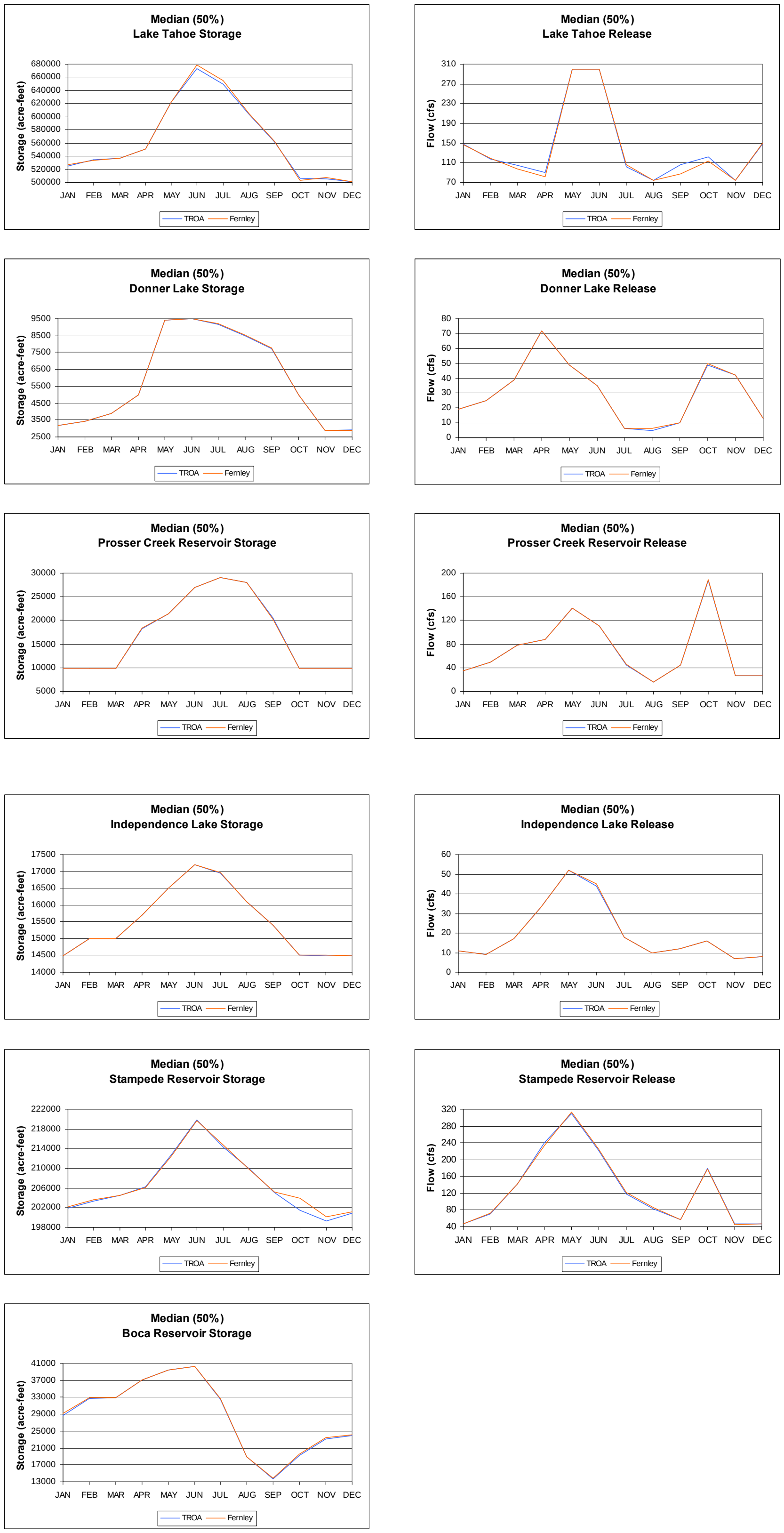


Figure 3.21.—Fernley scenario: Modeled reservoir storage and releases in median hydrologic conditions.

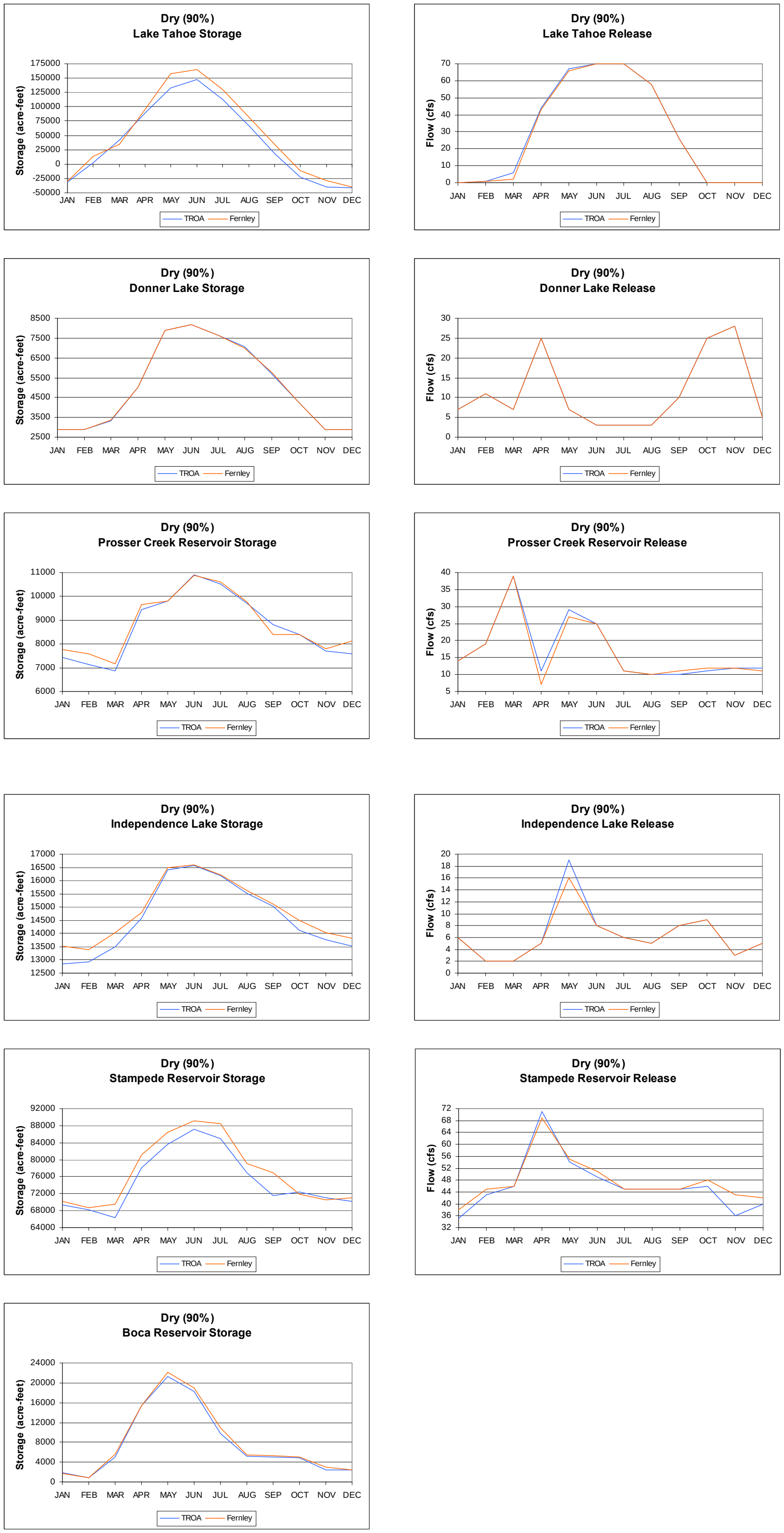


Figure 3.22.—Fernley scenario: Modeled reservoir storage and releases in dry hydrologic conditions.

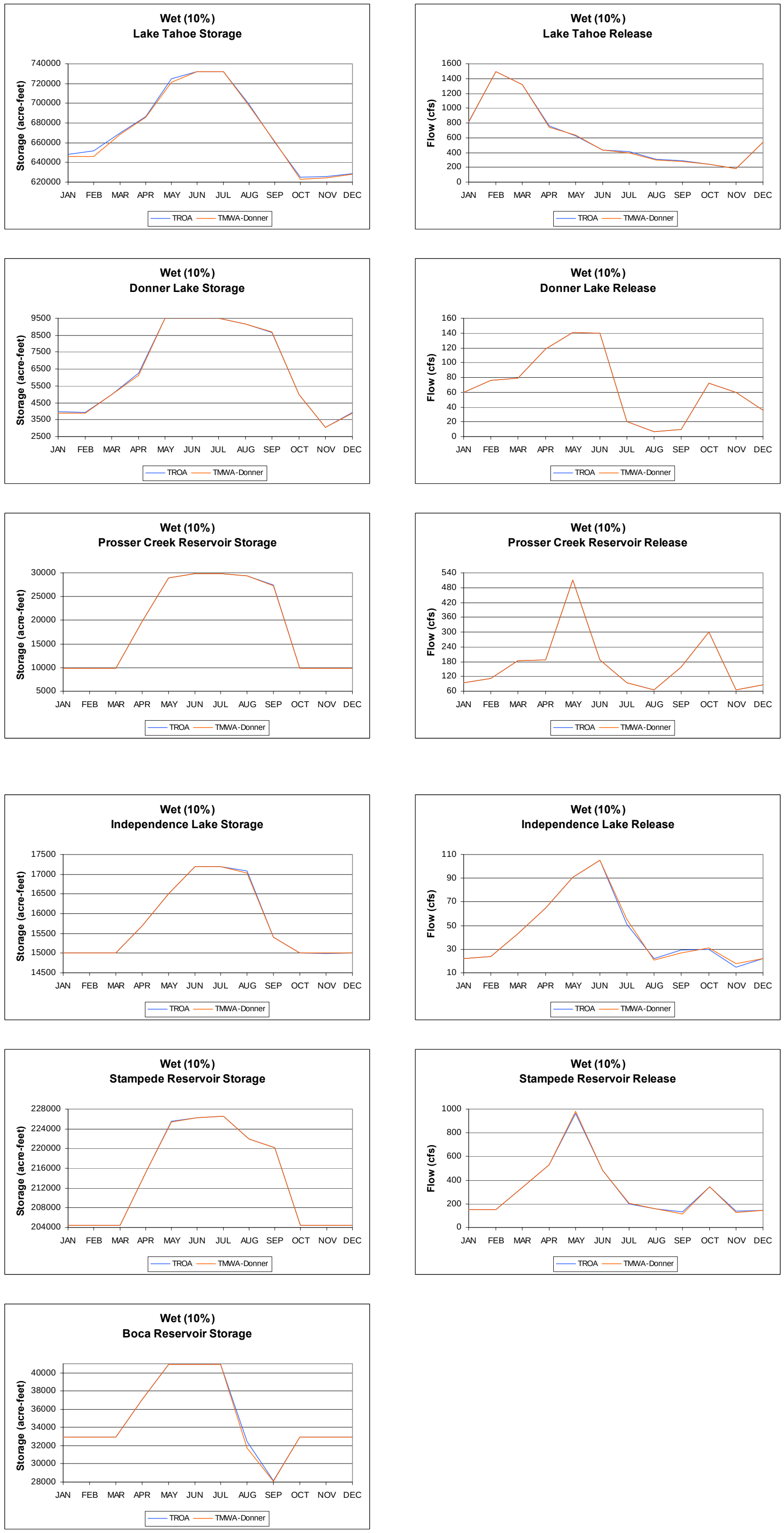


Figure 3.23.—Donner-TMWA scenario: Modeled reservoir storage and releases in wet hydrologic conditions.

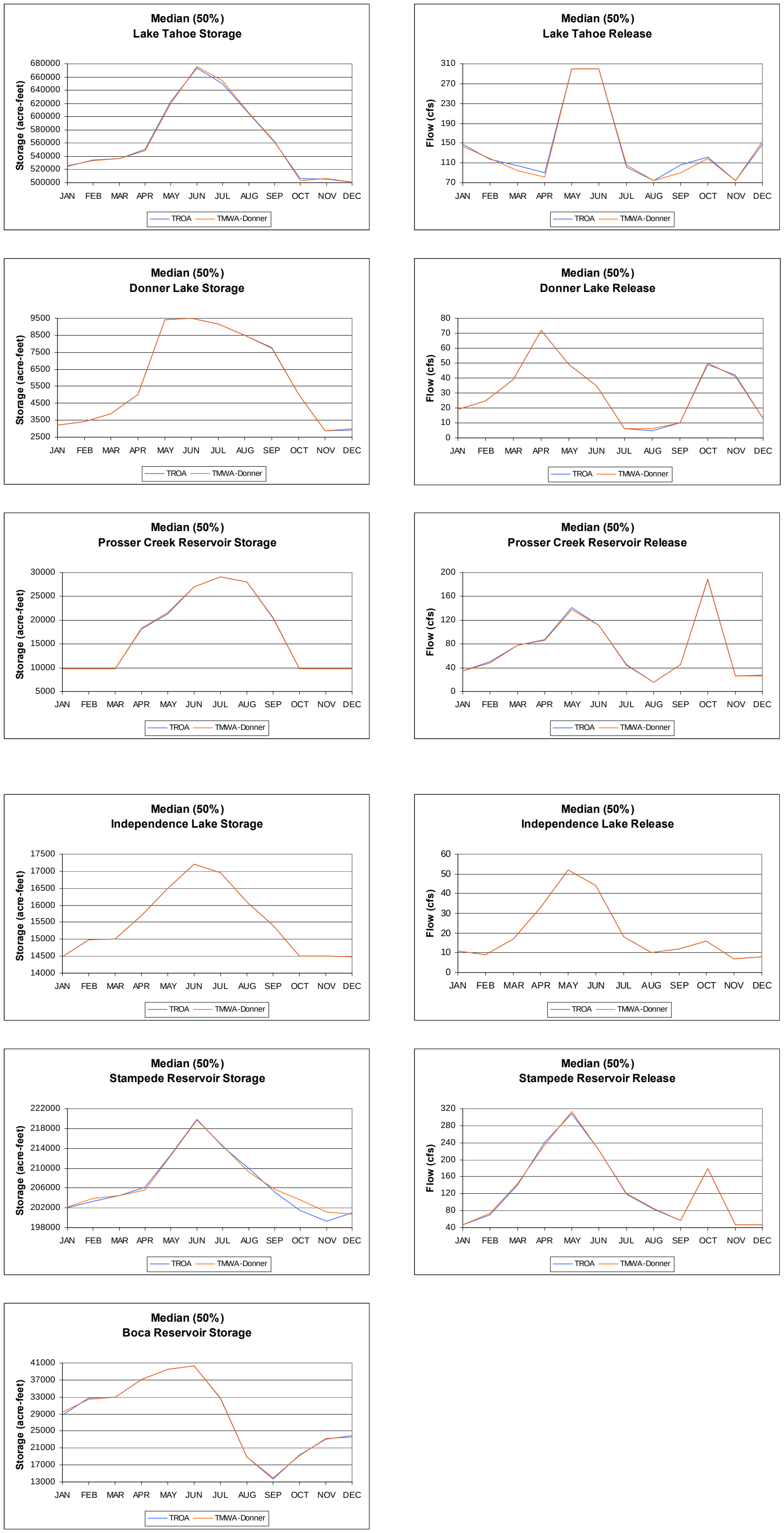


Figure 3.24.—Donner-TMWA scenario: Modeled reservoir storage and releases in median hydrologic conditions.

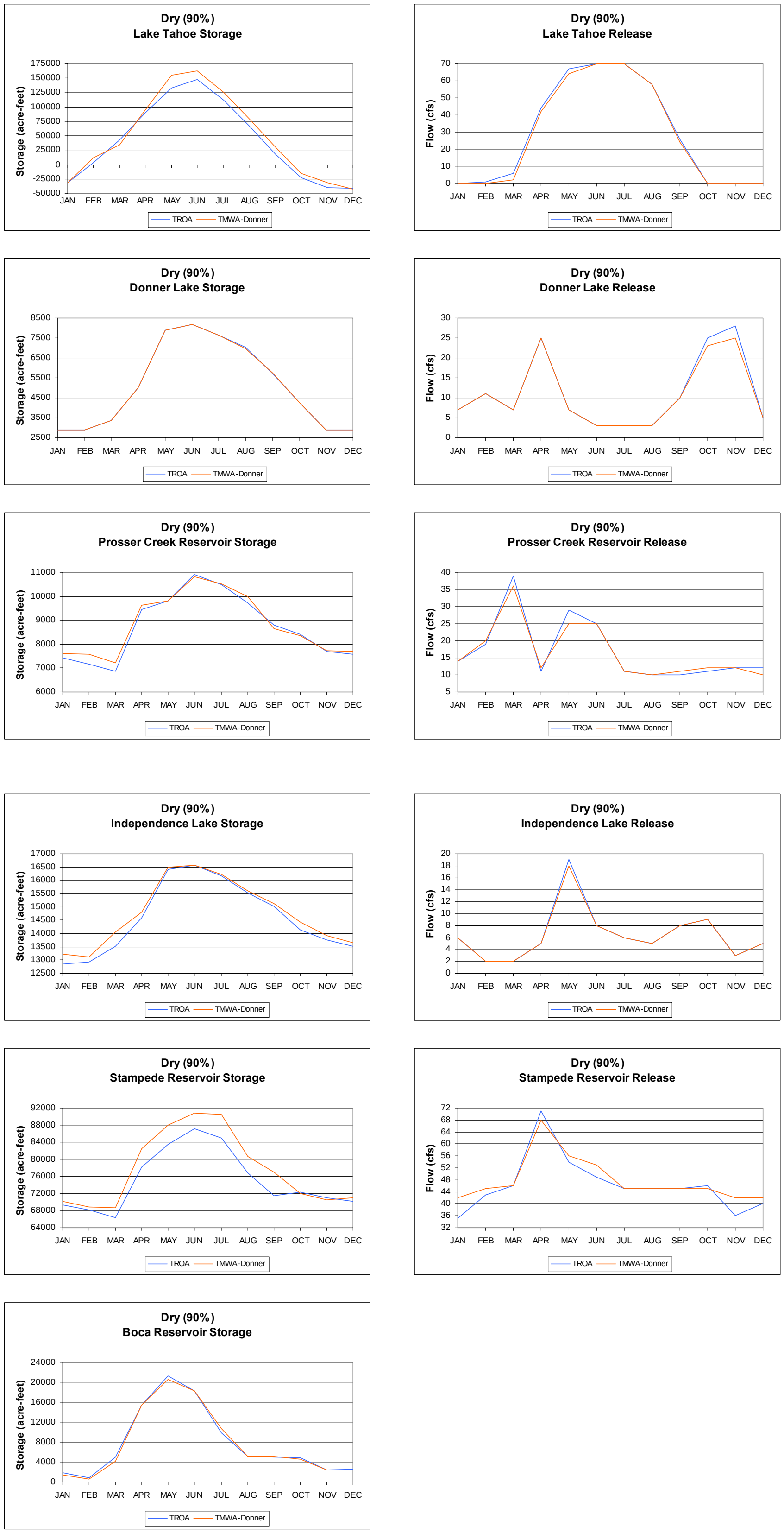


Figure 3.25.—Donner-TMWA scenario: Modeled reservoir storage and releases in dry hydrologic conditions.

greater. Total reservoir storage is slightly greater under the Donner-TMWA scenario than under TROA in dry hydrologic conditions because of additional storage of TMWA M&I Credit Water.

Wet hydrologic conditions	-420 acre-feet
Median hydrologic conditions	- 70 acre-feet
Dry hydrologic conditions	930 acre-feet

In dry hydrologic conditions, storage in each reservoir, except Donner Lake and Boca Reservoir, is slightly greater. Independence Lake storage is slightly greater, and releases are lower because Independence Lake is not used to meet M&I demands as frequently. Greater storage in Lake Tahoe and Stampede Reservoir in dry hydrologic conditions is the results of the storage of TMWA M&I Credit Water. On average, there is 2,120 acre-feet more TMWA M&I Credit Water under the Donner-TMWA scenario than TROA.

Average annual flows at Farad, Vista, and Nixon are the same under the Donner-TMWA scenario as under TROA.

Agricultural and M&I demands are met to the same degree under the Donner-TMWA scenario and TROA, except demands of the Carson Division demands. Under the Donner-TMWA scenario, the Truckee Canal diverts 120 acre-feet per year less water to Lahontan Reservoir. Carson Division average annual shortage is 80 acre-feet per year greater. This is caused by the loss of the Donner Lake supply.

Overall, reservoir storage is slightly greater in dry hydrologic conditions, and supply to the Carson Division is slightly less under the Donner-TMWA scenario than under TROA.

G. Certain Credit Waters

Certain categories of Credit Water were not included in model operations. It is possible to characterize the use of California Environmental Credit Water, California Additional California Environmental Credit Water, and Other Credit Water qualitatively, however, across a range of reasonably foreseeable scenarios. In each case, an uncertain amount of additional water, limited by the constraints in TROA, would be stored in upstream reservoirs for some period of time. This would mean that more water would be stored in the upstream reservoirs at various times under TROA than without TROA. Additional water in the reservoirs translates into additional recreational opportunity in those reservoirs. At the time the water is being stored, it also translates into lower flow in a portion of the Truckee River (and possibly a tributary), but increased flow when the water is released.

In the case of the two categories of California Environmental Credit Water, reserving storage opportunities for them was specifically sought by California in the TROA negotiations to improve flows within California for fish. Releases of that water would continue past the State line, thus also benefiting fish in Nevada, which is one of the reasons why the provisions, with constraints, were acceptable to all parties. Other reasons are that California would use this water specifically for environmental purposes, and the uses are non-consumptive except for a small share of evaporation (which minimizes total flow impacts in

Nevada). California would have the right and responsibility for optimizing the trade-offs and timing among storing its water rights versus letting the water flow to improve streamflows, retaining water in the reservoirs for recreation, and releasing water to increase streamflows. California M&I water storage could substitute for some diversions of surface water or use of groundwater in the basin for M&I use, and, while in storage, would enhance recreational opportunity to a limited extent (this category is limited to 3,000 acre-feet in most reservoirs, so the effect would not be large). California Environmental Credit Water, together with California M&I Credit Water, could be stored up to a total of 8,000 acre-feet, of which 3,000 acre-feet may be stored in Truckee River reservoirs other than Lake Tahoe. Additional California Environmental Credit Water could be stored—up to 10,000 acre-feet at any one time. They were not modeled or analyzed in the revised DEIS/EIR because their establishment is contingent on the purchase of water rights and the prospects for their future use are uncertain.

Other Credit Water, also addressed in the Draft Agreement, would be the lowest priority Credit Water managed pursuant to TROA. There are no proposals or assumptions for its use, and it was not included in model operations.

The establishment, storage, and release of each of these Credit Water categories may require further analysis under NEPA and/or CEQA. It is possible that some of these Credit Waters may never be used, but California's best estimate is that Credit Water could be expected to be used for M&I storage.

GROUNDWATER

I. AFFECTED ENVIRONMENT

This section provides an overview of groundwater supplies and demand in the study area.

In the California portion of the Truckee River basin, there is no regulatory limit on the right to extract groundwater. Under TROA, groundwater extraction would be limited to 32,000 acre-feet per year, less whatever surface water is diverted, with surface water currently limited to 10,000 acre-feet per year (P.L. 101-618). Estimated groundwater recharge is about 18,000 acre-feet per year in the Martis Valley basin. The Martis Valley Groundwater Management Plan notes that groundwater levels in wells adjacent to the Truckee River are higher than the river, which indicates that groundwater is moving into the river. In this setting, changes in river flow would have very little effect on adjacent groundwater levels.

Low-yield, private wells serve individual residences throughout the Truckee River basin, but most groundwater extraction occurs in Truckee Meadows, where municipal water purveyors, such as TMWA, operate production wells to supplement the surface water supply. Estimated groundwater recharge in Truckee Meadows is 29,000 acre-feet per year and comes from infiltration of precipitation (mainly snowmelt), return flows from surface water supplies used for irrigation, and seepage from ditches, canals, and streambeds. However, the total permitted, certificated, and vested groundwater rights recognized by the State Engineer in Truckee Meadows are 79,765 acre-feet per year, or about 50,000 acre-feet per year more than the perennial yield. TMWA holds certificated groundwater rights in the Truckee Meadows area for 41,811 acre-feet per year (TMWA, 2003) but has been limited by the State Engineer's Office to pumping only 12,000 to 18,000 acre-feet per year. TMWA has acquired an additional 1,340 acre-feet of existing groundwater rights that may be exercised without restriction.

Introduction of irrigation to Lahontan Valley created substantial recharge of the shallow aquifer from canal seepage and irrigation losses (USGS, 1993). Currently, numerous domestic wells tap the shallow aquifer for a reliable small water supply in and around Fernley and the Truckee Division of the Newlands Project. In the Carson Division, the shallow groundwater flow is generally from Fallon to the east, with a groundwater divide from Fallon to about Harmon Reservoir. Groundwater flow from this divide is generally to the northeast and also to the southeast. In the northeast, the shallow groundwater feeds the surface water ponds at Stillwater WMA. In the southeast, the shallow groundwater feeds the surface waters of Carson Lake (USGS, 1993).

Truckee River water is diverted into the Truckee Canal at Derby Diversion Dam for irrigation in the Truckee Division and for delivery to Lahontan Reservoir. Newlands Project OCAP have been promulgated to meet project irrigation requirements consistent with the *Orr Ditch* and *Alpine* Decrees while minimizing use of Truckee River water and maximizing use of Carson River water for project purposes. Truckee River water is diverted as necessary to satisfy the exercise of Truckee Division water rights consistent with OCAP. Generally, diversion of Truckee River water to the Truckee Division will vary directly with demand;

diversion to the Carson Division will vary directly with demand but inversely to and depending in large part on Carson River inflow to Lahontan Reservoir.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

The operations model does not model groundwater supplies used for domestic, irrigation, and M& I purposes. Groundwater use was included as input to the operations model as a part of the M&I supply, but this input did not include any estimates of the numbers of wells, location, amounts pumped or recharged, or any surface water-groundwater interface. TMWA has 28 production wells, of which 19 are fitted for pumping and recharge (TMWA, 2003); the operations model assumes the groundwater pumped would be available for future M&I uses. USGS (1996b) estimates as many as 4,500 domestic wells could tap the shallow aquifer around the Fallon area. Because the wells are shallow (less the 150 feet deep), they are dependent on surface recharge, which comes primarily from canal and irrigation seepage loss. The operations model does not model this seepage loss.

Future changes in the disposition and exercise of Truckee Division and Carson Division water rights are assumed to occur independent of TROA. Diversion of Truckee River water to satisfy a portion of the future Newlands Project water demand (described in “Water Resources”) will continue to be regulated by OCAP. The potential effects of TROA on the Newlands Project, therefore, would be measured most objectively by comparing the quantity of Truckee River water available for diversion at Derby Diversion Dam, and resulting Truckee Canal inflow to Lahontan Reservoir, Lahontan Reservoir storage, and Lahontan Reservoir releases to the lower Carson River under the alternatives. It is assumed that agricultural demand on the Newlands Projects would decrease in the future under any alternative due to the acquisition and transfer of those rights for other beneficial uses; a decrease in Newlands Project demand would result in a decrease in diversions from the Truckee River to the Truckee Canal.

Therefore, a qualitative analysis was conducted to evaluate the effects of modifying operations of Truckee River reservoirs on groundwater using the following indicators:

1. Recharge of the shallow aquifer adjacent to the Truckee River, as assessed by stream losses in the Oxbow reach (Hunter Creek to Highway 395, shown on map 3.1). This area relates to TMWA production wells and others that could be affected by changes in flow.

2. Recharge of the shallow aquifer in Truckee Meadows, as assessed by transfer of agricultural water rights to M&I use. Estimated recharge of the aquifer is 25 to 50 percent of the applied irrigation water (Cohen, 1964).

3. Recharge of the shallow aquifer near the Truckee Canal, as assessed by comparing flow in the Truckee Canal at Derby Diversion Dam and Lahontan Reservoir generated from the operations model.

4. Effects of well pumping on the shallow aquifer, as assessed by expected future groundwater use.

B. Summary of Effects

Analysis shows no measurable change to the shallow aquifer near Truckee Meadows (adjacent to the Oxbow reach of the Truckee River) under any of the alternatives. Effects on the shallow aquifer in Truckee Meadows and establishment of a new groundwater equilibirium would vary among the alternatives and depend upon many local factors, such as the amount of groundwater pumping, recharge, and the localized groundwater flow gradients. Seepage loss from the Truckee Canal would be similar under all alternatives. With criteria established for new well construction, assumed limitations on groundwater use, and development of surface water drought supplies, TROA likely would have the least effect on future groundwater resources among the alternatives.

Table 3.14 summarizes the effects on groundwater.

Table 3.14.—Summary of effects on groundwater

Indicator	No Action	LWSA	TROA
Recharge of aquifer adjacent to Truckee River in the Oxbow reach	Slightly less than under current conditions.	Same as under No Action.	Slightly more than under No Action; same as under current conditions.
Recharge of the shallow aquifer in Truckee Meadows	Slightly less than under current conditions.	Similar to No Action.	Possibly less than under No Action depending on current land use.
Recharge of shallow aquifer near Truckee Canal due to seepage loss	Less than under current conditions.	Similar to No Action.	Similar to No Action.
Well pumping in the shallow aquifer	Slightly less than under current conditions.	Same as under No Action, except slightly more in dry hydrologic conditions.	Slightly less than under current conditions, except in dry hydrologic conditions.

C. Recharge of the Shallow Aquifer Adjacent to the Truckee River in the Oxbow Reach

1. Method of Analysis

The Truckee River can have a component of seepage loss to the adjacent shallow aquifer, although some reaches, where the river channel is incised in rock or dense soils, have no (or very little) seepage. Conversely, some reaches of the Truckee River receive groundwater flow, or are “gaining,” when the water level of the adjacent shallow aquifer is higher than that of the river channel. For this analysis, the Oxbow reach of the Truckee River was used to compare flows and the associated potential for recharge (seepage loss) of the adjacent shallow aquifer because this reach provides a setting where the river water level interacts with the adjacent water table (groundwater levels). Flows were generated from the operations model for current conditions and the alternatives in wet, median, and dry hydrologic conditions.

A similar comparison of the water depths in the river could be more indicative of the potential effect on seepage loss. For purposes of this evaluation, changes in river flow would result in a change in river water depth, which could affect seepage to the adjacent aquifer. Water depths represent the hydraulic driving force available to "push" water from the river into the adjacent aquifer. A change in the depth of flow under the alternatives provides a comparison of the effect of flow on potential river seepage loss.

This shallow aquifer is complex, with abrupt vertical and horizontal changes in lithology, and estimating changes to it based on Truckee River flow is difficult. Such estimates can only be subjective and illustrate relative differences between alternatives.

2. Threshold of Significance

Insufficient information is available to determine a numeric threshold of significance. This analysis provides a subjective assessment of the relative differences in seepage loss, and best professional judgment was used to determine significance.

3. Model Results

Table 3.15 compares average annual estimated stream loss in the Oxbow reach in wet, median, and dry hydrologic conditions. For comparison purposes, estimated stream loss is simply a percent of flow loss rate applied to the monthly flows. A change in estimated stream loss represents the potential for change to the adjacent aquifer. The estimated stream loss is representative of water that becomes groundwater when the adjacent shallow aquifer is both connected to the stream and has water elevations lower than the stream.

Table 3.15.—Average annual stream loss in Oxbow reach of the Truckee River

Hydrologic condition	No Action	LWSA	TROA
Wet	4 percent less than under current conditions.	Same as under No Action.	4 percent more than under No Action; same as under current conditions
Median	6 percent less than under current conditions.	Same as under No Action .	Same as under No Action.
Dry	5 percent less than under current conditions.	1 percent less than under No Action; 6 percent less than under current conditions.	1 percent more than under No Action; 4 percent less than under current conditions.

4. Evaluation of Effects

a. No Action

Average annual stream loss would be 4 to 5 percent less under No Action than under current conditions.

b. LWSA

Average annual stream loss could be 1 percent less under LWSA than under No Action and 4 to 6 percent less than under current conditions. These differences are very small and are not expected to affect the adjacent shallow aquifer. Similarly, considering the change in water depth, no discernable change is expected in stream seepage loss.

c. TROA

Overall, in wet, median, and dry hydrologic conditions, the potential stream loss to the adjacent aquifer would range from 6 percent less to 5 percent more under TROA than under No Action and current conditions. These differences are very small and are not expected to affect the adjacent shallow aquifer. The monthly flow pattern under TROA could result in some small, short-term changes compared to No Action and current conditions; however, the local aquifer response is not immediate and depends upon other variables.

Change in flow depth is 2 percent less to 1 percent more under TROA than under No Action and current conditions. Because of the many natural variables within the stream/aquifer setting, the estimated differences in stream loss are not expected to result in any measurable change to the adjacent shallow aquifer.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

D. Recharge of the Shallow Aquifer in Truckee Meadows

1. Method of Analysis

This analysis evaluated the effect of transferring agricultural water rights to M&I use on recharge of the local aquifer. Loss of canal seepage and deep percolation on the irrigated fields would reduce local groundwater recharge.

Changes in groundwater withdrawal due to well pumping and installation of new wells for municipal pumping are expected to affect the shallow aquifer. The effects can only be described generally because of many variables, such as location of well, type of aquifer, depth of well screens, timing of pumping, and incorporation of a recharge cycle.

2. Threshold of Significance

Because of the many variables associated with the transfer of agricultural water rights, including the locations of the irrigated fields, the amounts of water actually applied to the fields, the timing of irrigations, and soil permeability properties, this analysis provides a subjective assessment of the relative differences in seepage loss, and best professional judgment was used to determine significance.

3. Evaluation of Effects

As discussed elsewhere, the operations model assumes that agricultural water rights would be reduced by 13,368 acre-feet through purchases in Truckee Meadows under No Action and LWSA compared to current conditions; an additional 12,000 acre-feet of agricultural water rights would be purchased under TROA.

This transfer could result in land use changes in both Truckee Meadows area and the Truckee Division. The proposed change in water applied to the land would result in less water that passes the crop rootzone to become local groundwater recharge.

To estimate the magnitude of change to the shallow aquifer resulting from the loss of this recharge, several assumptions were necessary. Acreage changes under TROA were used to develop these assumptions; less change would be expected under No Action and LWSA. Assuming that about 25 percent of the irrigation amount contributes to groundwater recharge, there is potential recharge reduction of 6,330 acre-feet per year in Truckee Meadows. Also, assuming the soil specific yield is 15 percent, and that the irrigated lands are all contiguous (which they are not), then the water table response would be an estimated decline of 6.7 feet per year under TROA. If the irrigated acreage were mixed with other land uses at about 50 percent, then the water table response would be a decline of about 3.35 feet per year. These estimates should not be interpreted to conclude that the water table would continually decline 3 to 6 feet per year, because, at some depth, a new equilibrium would be established. The new equilibrium would depend upon many local factors, such as the amount of groundwater pumping, recharge, and the localized groundwater flow gradients. Other municipal setting factors, such as the reduction of natural infiltration due to paving, the extent and efficiency of lawn watering, housing coverage, and storm water controls, make this groundwater depth even more difficult to predict.

4. Mitigation

No mitigation would be required because recharge of the shallow aquifer in Truckee Meadows would not be significantly affected under any of the alternatives.

E. Recharge of the Shallow Aquifer near the Truckee Canal

Recharge of the local shallow aquifer near the Truckee Canal is influenced by canal seepage loss. The rate of seepage loss from the Truckee Canal and the recharge of the local shallow aquifer have been investigated by others (USGS, 2000). Estimated canal seepage loss has been reported in the range of 0.8 to 4.0 cfs per mile of canal. The general estimate of all losses from canals, spills, and onfarm irrigation losses are 64 percent of the diversion supply (CH2M Hill, 1973). Changes in canal seepage loss related to changes in flows in the Truckee Canal would affect local aquifer recharge.

1. Method of Analysis

Seepage losses are dependent upon how much water is carried in the Truckee Canal; therefore, this indicator was evaluated by comparing operations model output of average flow in the Truckee Canal at Derby Diversion Dam and Lahontan Reservoir. Additionally, average Lahontan Reservoir storage and releases were included to identify potential effects on water availability for diversion on the Carson Division. Evaluation of specific aquifer effects are subjective because of the variability in aquifer geology, locations of irrigated lands, and the degree to which an irrigation water right has been used.

2. Threshold of Significance

This analysis provides a subjective assessment of the relative differences in shallow aquifer recharge near the Truckee Canal based on Truckee Canal flow. Best professional judgment was used to determine significance; however, no new data has been collected and only existing reports and model outputs could be cited.

3. Model Results and Evaluation of Effects

Operations model results for the identified parameters are shown in table 3.16.

Table 3.16 Truckee Canal flows and Lahontan Reservoir storage and releases
(1,000 acre-feet per year)

	No Action	LWSA	TROA
Diversion to Truckee Canal (at Derby Diversion Dam)	51.81	51.67	51.78
Truckee Canal inflow to Lahontan Reservoir	43.84	43.72	43.75
Lahontan Reservoir storage (end of June)	225.28	225.15	224.82
Lahontan Reservoir releases (to Carson Division)	303.40	303.29	303.36

Operations model results show little difference between TROA and the other alternatives, with only slightly less water being provided under TROA. This situation occurs because upstream senior Truckee River water rights are more able to be fully exercised by these water rights holders to create Credit Water under TROA. Effects on Newlands Project water use should be minimal. Average annual releases from Lahontan Reservoir are similar (differences of no more than 110 acre-feet) under all alternatives, and delivery to agriculture and wetlands uses would not be affected to a measurable degree. Application of water to the land would be similar. Any effects on Newlands Project groundwater resources in the study area would result primarily from changes in the amount of Truckee River water diverted to the Truckee Canal to flow to Lahontan Reservoir and would be less than the minor differences between the parameters shown in table 3.16. Changes in flow would affect slightly the amount of seepage to the shallow aquifer adjacent to the canal; the other effect of changes in flow would relate to Lahontan Reservoir releases to the Carson Division. The minor reductions in Truckee Canal flow and Lahontan Reservoir release for irrigation on the Carson Division would have no measurable effect on groundwater resources on the Newlands Project. Diversions to the Truckee Division would not be measurable affected.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

F. Effects of Well Pumping on the Shallow Aquifer

1. Method of Analysis

Groundwater pumping can cause the water level in shallow aquifers to decline if there is a connection between the pumping depth and the shallow aquifer. The response in the aquifer is dependent on the rate of pumping, the hydraulic properties of the aquifer, and a number of other variables at each pumping site. Generally, increased pumping of the shallow water aquifer lowers the shallow water table elevations. Conversely, continued aquifer recharge projects tend to raise the shallow water table elevations.

This indicator was evaluated by comparing groundwater use assumed in the operations model under current conditions and the alternatives in wet, median, and dry hydrologic conditions.

2. Threshold of Significance

Because insufficient information is available to determine a numeric threshold significance, this analysis provides a subjective assessment of the relative differences among alternatives, and best professional judgment was used to determine significance.

3. Model Results

Table 3.17 presents projected groundwater use Truckee Meadows in wet, median, and dry hydrologic conditions under current conditions and the alternatives, as assumed in the operations model.

Table 3.17.—Projected groundwater use in Truckee Meadows (acre-feet)

Hydrologic condition	Current conditions	No Action	LWSA	TROA
Wet	12,820	12,570	12,570	12,570
Median	14,820	12,570	12,470	12,570
Dry	16,350	15,120	16,020	12,990

4. Evaluation of Effects

Analysis of the effects on water table elevations is not possible without knowing details such as the location, pumping schedule, and the hydrologic and geologic setting of each well. However, on the basis of the expected maximum predicted dry year uses, TROA is expected to have the least effect on future groundwater resources among the alternatives.

Groundwater use in the Truckee River basin in California is expected to increase from 7,570 acre-feet per year to 19,600 acre-feet per year under No Action. This increase could affect shallow water table elevations. Also, depending upon the location of future wells and the timing of groundwater extraction, potential effects on local streams could range from minor increases in stream losses to changing stream reaches from gaining to losing. As discussed in chapter 2, Article Ten of the Draft Agreement provides some regulations for the location and well construction. The objective of Article Ten is to minimize the effect of groundwater withdrawals (well pumping) on the surface water resources by establishing setback distances from streams, rivers, and ponds. Other requirements such as well construction and seal methods are included in Article Ten to help minimize effects on the surface water resources. With the implementation of Article Ten (only under TROA), the increased use of groundwater in the Truckee River basin in California should have limited effect on the surface stream and rivers.

Water budgets presented in “Groundwater Availability in the Martis Valley Ground Water Basin and Placer Counties, California (Nimbus, 2001) show that the average annual groundwater recharge in the Truckee River basin in California is about 34,600 acre-feet per year, at the current pumping of 7,060 acre-feet per year, while about 17,640 acre-feet flows out of the area.

Under No Action, groundwater use in the Truckee River basin in California would increase to 12,030 acre-feet to meet greater future demand. It is not known where this increased pumping would occur. However, if it were to occur in the Martis Valley basin, this could reduce the basin groundwater and flow to only 5,610 acre-feet (17,640 - 12,030 = 5,610). Even though this is a fairly large reduction, there is still positive outflow. This is an example of the order of magnitude of the pumping increase and points to the aquifer’s capacity to handle this pumping withdrawal. Similarly, the groundwater use estimated for LWSA and TROA would increase slightly less (10,830 acre-feet), so effects also should be slightly less than under No Action.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

WATER QUALITY

I. AFFECTED ENVIRONMENT

This section provides an overview of water quality in the study area and describes aspects of water quality that could be affected by modifying operations of Truckee River reservoirs.

Bender (1995) summarized historical Truckee River water quality data (through 1992) for the Truckee River basin from Lake Tahoe to Pyramid Lake; several data bases, which include many water quality parameters, were assessed separately. The following overview of water quality is based on data and water quality modeling for the Truckee River.

As the Truckee River flows from Lake Tahoe to Pyramid Lake, pollutants, including nutrients and total dissolved solids (TDS) resulting from natural erosion of the watershed and from the effects of humans, enter the river and degrade the water quality. Additionally, water is diverted for agricultural and M&I uses and is returned to the river in diminished quantity and quality. Available data did not reveal any major sources of contamination other than erosion of the watershed, agricultural runoff, and wastewater treatment plant discharges.

Metals in the Truckee River and its tributaries are not a major concern, although some concentrations are excessive on rare occasions. For example, historical data indicate that cadmium, lead, manganese, nickel, and thallium concentrations occasionally violated State and Federal standards. While silver and zinc concentrations were occasionally elevated in fish and invertebrate tissues, available tissue data did not reveal any excessive bioaccumulation. Naturally occurring radioactive materials are not a major concern because of low concentrations and localized occurrence.

A. Truckee River Basin: Lake Tahoe to Reno

Lake Tahoe is considered a pristine water resource. Water quality issues at Lake Tahoe are being studied and addressed by interstate agencies. Because it has been designated an “Outstanding Natural Resource” under the Federal Clean Water Act of 1972, no man-induced degradation of Lake Tahoe's water quality is allowed. In California, Lake Tahoe has been designated as “water of extraordinary ecological or esthetic value.”

The upper portion of the Truckee River basin, from Lake Tahoe to Reno, is relatively pristine with few contaminants and nutrients. Low concentrations of dissolved oxygen (DO), which are harmful to fish, are not a concern, primarily because of reaeration of this steep, tumbling stream reach and low demand for oxygen from organic decay.

The primary concerns are occasional warm temperatures and dilution of return flows from the Tahoe-Truckee Sanitation Agency and the Truckee Meadows Water Reclamation Facility wastewater treatment facilities. TTSA, which serves the town of Truckee and part of the community around Lake Tahoe, is located just upstream of the confluence of Martis Creek and the Truckee River. TMWRF is located downstream from Reno. In warm weather, low flows, warm reservoir releases, and warm drainage return flows can cause the Truckee River to warm to temperatures that are detrimental to fish. Historical data indicate that temperatures between the State line and Reno occasionally violate acute (instantaneous exposure) and chronic (prolonged exposure) limits for trout during July and August (Bender, 1995). Cool water, if released from Prosser Creek and Boca Reservoirs, can lower temperatures in the river; however, when reservoir water elevations are low, warm waters are released. These warm releases and low flows can result in fish kills between the California-Nevada State line and Reno, as occurred during the summer of 1994.

Lakes and reservoirs between Lake Tahoe and Reno do not appear to have major water quality problems, although thermal stagnation due to minimal flushing and long residence time of bottom waters can result in low concentrations of DO in the bottom layers of Prosser Creek, Stampede, and Boca Reservoirs. However, bottom water aerates quickly once released, thereby increasing DO concentrations to near saturation.

B. Truckee River Basin: Reno to Pyramid Lake

The primary concerns for the Truckee River basin from Reno to Pyramid Lake are warm temperatures and low DO concentrations. In warm weather, temperatures gradually increase downstream, especially in the flatter reach downstream from Reno, where flow velocities are slower. Warm temperatures and slower velocities allow algae attached to the river bottom to accumulate, increasing organic matter. Decay of organic matter, such as dead algae, can result in low concentrations of DO. (See “Violations of Temperature and Dissolved Oxygen Standards.”) Nutrients, which are abundant downstream from TTSA and TMWRF, help stimulate excessive algal growth in the Truckee River. Excessive algal growth downstream from Derby Diversion Dam also causes low DO concentrations.

TDS concentrations in the Truckee River also increase downstream and are a concern because Pyramid Lake is a terminal saline lake. Both temperature and salinity affect density stratification of the water layers of Pyramid Lake. Long periods of stratification lead to oxygen-deficient bottom waters, which stress cold water organisms. Below-average freshwater flow and high evaporation rates increase TDS concentrations in the surface waters of Pyramid Lake and can facilitate early turnover by increased mixing which replenishes oxygen-deficient bottom waters. Above-average freshwater flow can dilute the salinity of surface waters so that mixing of Pyramid Lake during winter might be physically impossible due to density differences. A steady decline in the elevation of Pyramid Lake would reduce the probability of mixing events.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

Modifying operations of Truckee River reservoirs could affect lake and reservoir storage and elevations and the quantity, timing, and duration of flows. These changes could result in daily, seasonal, and annual changes in Truckee River water quality and loadings to Pyramid Lake.

This analysis evaluated the effects of changes in reservoir storage and water elevations and flows on water quality using the following indicators:

- Truckee River flow in August (irrigation month) and October (non-irrigation month) at three locations: (1) upstream of TTSA, (2) downstream from TMWRF, and (3) the inflow point to Pyramid Lake in wet, median, dry, and very dry hydrologic conditions (10-, 50-, 90-, and 95-percent exceedences).

- Annual total of days that Nevada State water temperature standards are violated downstream from Reno.

- Annual total of days that Nevada State DO standards are violated downstream from Reno.

- TDS loadings to Pyramid Lake.

- Total nitrogen loadings to Pyramid Lake.

- Total phosphorus loadings to Pyramid Lake.

Truckee River flow is the most important indicator because it dilutes poor quality water and ties directly to reservoir operations.

TDS (salt) and nitrogen and phosphorus (nutrient) loadings to Pyramid Lake were chosen as indicators because loadings are the output of the Dynamic Stream Simulation and Assessment Model with temperature (DSSAMt) and the input to the Pyramid Lake water quality model. Loading to Pyramid Lake is the linkage between watershed/riverine drainage modeling and the Pyramid Lake modeling.

The Truckee River transports nitrogen from California to Nevada. However, interstate total maximum daily load (TMDL) issues are outside the scope of this water quality analysis. See Chapter 4, “Cumulative Effects,” for a discussion of TMDL issues.

B. Summary of Effects

Under TROA, water stored in wet and median years would be used to improve riverine water quality in dry years, the most critical periods for aquatic resources, including fish. In the Truckee River basin from Lake Tahoe to Reno, based on a review of historic data and best professional judgment, where compared against California water quality standards, under TROA, there would be no significant adverse effect on water quality. In the Truckee River basin from Reno to Pyramid Lake, water quality standards would be met more often in representative dry years and the same or occasionally less often in median years under TROA than under No Action or current conditions. For example, Truckee River TDS standards in the lower reaches downstream of Reno may be met less often under TROA, and more TDS loading may be delivered to Pyramid Lake in median years because of higher flows. However, when considering several water quality indicators, such as DO, temperature and TDS, the total water quality benefits realized in dry years under TROA would outweigh occasional adverse effects in median years. In general, greater inflow to Pyramid Lake and the resulting higher elevation under TROA would be favorable for water quality. There are no significant water quality problems in representative wet years.

Table 3.18 presents operations model results for flows in two representative months at three representative river locations in wet, median, dry, and very dry hydrologic conditions. Operations model results show that flows at the three locations are the same or nearly the same under No Action, LWSA, and TROA as under current conditions, except in dry and very dry hydrologic conditions. In dry and very dry hydrologic conditions, flows downstream from Reno and into Pyramid Lake are greater under TROA than under No Action or current conditions. In very dry hydrologic conditions, flows downstream from Reno are greater under TROA than under No Action. Under TROA, flows are adequate to dilute wastewater downstream from both TTSA and TMWRF discharge points to acceptable levels. Flows under LWSA are nearly the same as under No Action.

Table 3.19 summarizes other indicators of water quality for representative wet, median, and dry years. These years (1986: wet; 1989: median; and 1992: dry) were chosen based on recent operations rather than a long-term record. Overall, DSSAMt results show that Truckee River water quality would be better under TROA than under No Action, as shown by the number of days Nevada State temperature and dissolved oxygen standards are violated downstream from Reno. These temperature and DO indicators are the most telling indicators of water quality.

Table 3.20 summarizes TDS, total nitrogen, and total phosphorus loadings to Pyramid Lake. These mass loadings were derived by multiplying concentration times flow. Loadings to Pyramid Lake are higher under TROA than under current and No Action conditions in representative median and dry years. Overall, however, DSSAMt results show greater differences in water quality among representative wet, median, and dry years than between No Action and TROA. As shown in table 3.20, the majority of loading to Pyramid Lake occurs in representative wet years, but the cumulative loadings (i.e., total combined loadings in representative wet, median, and dry years) to Pyramid Lake themselves differ little (less than 10 percent) between the alternatives and current conditions. Greater loading indicates that, cumulatively, more flow reaches Pyramid Lake under TROA.

Table 3.18.—Truckee River average monthly flows (cfs) for selected months and reaches

Hydrologic condition	Current conditions	No Action	LWSA	TROA
August flow upstream of TTSA				
Wet	442	441	442	329
Median	110	110	110	116
Dry	68	67	66	68
Very dry	25	24	24	21
August flow downstream from TMWRF				
Wet	456	422	422	401
Median	369	339	338	360
Dry	242	288	288	323
Very dry	83	141	141	196
August flow into Pyramid Lake				
Wet	300	300	300	300
Median	200	264	265	262
Dry	109	110	110	122
Very dry	27	79	79	110
October flow upstream of TTSA				
Wet	340	347	348	307
Median	260	270	271	201
Dry	23	29	31	41
Very dry	5	12	14	21
October flow downstream from TMWRF				
Wet	683	729	729	650
Median	434	458	458	449
Dry	181	177	174	205
Very dry	60	75	76	114
October flow into Pyramid Lake				
Wet	674	711	710	631
Median	396	429	429	432
Dry	100	109	109	104
Very dry	25	35	35	56

Table 3.19.—Summary of modeled violations of temperature (T) and dissolved oxygen (DO) standards

Representative year	Current conditions	No Action	LWSA	TROA
Days T standards violated Lockwood-Derby				
Wet	32	32	32	29
Median	28	32	27	28
Dry	85	120	119	87
Days DO standards violated Lockwood-Derby				
Wet	0	0	0	0
Median	0	0	0	0
Dry	109	42	39	3

Table 3.20.—Summary of loadings to Pyramid Lake

TDS loading to Pyramid Lake (100,000 kilograms)				
Wet	1,243	1,238	1,237	1,222
Median	355	346	345	353
Dry	143	119	120	176
Total nitrogen loading to Pyramid Lake (1,000 kilograms)				
Wet	358	368	365	344
Median	65	67	67	70
Dry	12	11	11	20
Total phosphorus loading to Pyramid Lake (1,000 kilograms)				
Wet	40	41	41	39
Median	7	7	7	7
Dry	1.6	1.4	1.4	3.1

Under TROA, water stored in wet and median years would be used during warm periods in dry years, the times with primary water quality concerns. Therefore, water quality typically would be better under TROA in representative dry years than under No Action or current conditions.

Tables 3.18, 3.19, and 3.20 summarize a large amount of information for purposes of comparing alternatives. Detailed modeling information for all locations and reaches, for shorter periods of time, for wet, median, and dry hydrologic conditions, and for many water quality constituents are provided by Brock and Caupp (2003) in two volumes for each alternative. Additional information is provided in the Water Quality Appendix, including summary tables of the water quality simulations (DSSAMt tables 1 through 12) and the fish water temperature simulations (DSSAMt tables 13 through 24).

C. Overview of Methods of Analysis

Two methods were used to analyze water quality: (1) a historical data analysis of the entire Truckee River system, and (2) a computer modeling analysis of the Truckee River from just downstream from the California-Nevada State line to Pyramid Lake. The reach downstream from Reno, the flatter river reach, has marginal or degraded water quality and is the focus of the modeling**.** The historical data analysis was used to identify water quality concerns throughout the Truckee River basin. Historical data were compared with water quality standards; the following section summarizes water quality standards for California waters affected by TROA. DSSAMt was used to quantitatively compare riverine water quality under current conditions and the alternatives. Brock et al. (2004) provide a complete model formulation and program description. Brock and Caupp (2004) provide a complete description of water quality standards and model calibration, verification, performance, input sensitivity, and simulated river temperatures and water quality. These documents are referenced in the water quality appendix. Summary statistics for the DSSAMt water quality model calibration/verification are included in the Water Quality Appendix.

Upstream and tributary flow and DSSAMt input boundary conditions were derived from Watershed Analysis Risk Management Framework (WARMF) model output. To correspond with flows and operations used for current conditions, flow inputs for the WARMF model were developed from operations model output, while land use changes were used to predict changes in nonpoint sources. Land use from 1999 was used for current conditions, and predicted land use in 2020 was used for the alternatives.

To formulate point source loadings from TTSA for current conditions, partial installation of the biological nitrogen removal (BNR) technology was assumed for the alternatives. BNR is environmentally superior to the existing anion exchange technology and has the ability to minimize TDS and chloride increases in the Truckee River while achieving target nitrogen concentrations. These upgrades will greatly reduce the salt loads reaching Nevada and, ultimately, Pyramid Lake. However, nitrate loadings from TTSA would increase by the year 2033 because of a projected maximum 7-day average municipal wastewater flow increase under current conditions of 7.4 million gallons per day to 9.6 million gallons per day under the alternatives.

Point source loadings for TMWRF were derived for current and a realistic future wastewater treatment process. Because of increases in population or development and corresponding increases in wastewater discharges with the existing wastewater treatment plant operations and future streamflows, the modeled TMWRF total nitrogen mass loadings were consistently projected to exceed permitted values. A major component of the total nitrogen is organic nitrogen, which is not readily bioavailable and likely does not substantially add to algal biomass or result in low DO. Therefore “total” nitrogen standards are violated frequently; however, DO standards are violated infrequently, especially under TROA.

The analysis assumes that cities and counties will attempt to meet future Truckee River water quality objectives by constructing additional treatment facilities, providing additional dilution water, or by spreading wastewater over agricultural lands with makeup water provided to the Truckee River. TMWRF managers have recognized the total nitrogen and organic nitrogen issues and are studying cost-effective approaches. DSSAMt assumes that State and local governments would implement sufficient mechanisms as populations grow to treat wastewater and limit urban runoff to maintain adequate riverine water quality, including storm water best management practices (BMP) and TMDLs.

DSSAMt simulates hourly changes in 26 water quality parameters for 105 subreaches of the Truckee River. Automated plots and tables of summarized information were generated for analysis. Results include data on all indicators of water quality except Truckee River flow.

Inputs to DSSAMt include flows generated from the operations model, actual meteorological data, actual water quality data, initial and boundary water quality conditions derived from WARMF, and water quality standards and preferred temperatures.

Flows generated from the operations model and actual air temperature data were used to predict water temperature and DO concentrations and loadings to Pyramid Lake. (See the Water Quality Appendix for definitions of representative wet, median, and dry years.)

Truckee River flow was generated from the operations model for wet, median, dry, and very dry hydrologic conditions in representative months at representative locations.

These indicators and the methods of analysis are appropriate for assessing potentially significant effects on water quality. However, no certain correlation exists between the indicators and all other water quality constituents. Therefore, 9 years of data were used to calibrate and verify the temperature and water quality components of DSSAMt to reduce the uncertainty of analysis.

D. Summary of Pertinent Water Quality Standards for California Waters

The term “water quality standards” is defined in regulations that implement the Federal Clean Water Act:

> Water quality standards are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water, and serve the purposes of the act (40 Code of Federal Regulations [CFR] 130.2(d) and 131.3(i)).

Thus, water quality standards must contain at least two critical components: (1) the designation of beneficial uses of water (Water Quality Appendix) and (2) the establishment of water quality criteria designed to protect those uses.

In California, the Water Quality Control Plans contain the State’s water quality standards because these plans set forth beneficial uses of water of the State and water quality objectives (the “criteria” under the Clean Water Act) to protect those uses. One critical difference between the State and Federal programs is that while the Clean Water Act focuses on surface water resources, the term “waters of the state” under the Porter-Cologne Act includes both surface and groundwater. Therefore, California has water quality standards applicable to groundwater as well as to surface water. The Porter-Cologne Water Quality Control Act is found in Division 7 of the California Water Code.

California's water quality standards include designated beneficial uses and narrative and numerical water quality objectives. Twelve different beneficial uses apply to Lake Tahoe, and 14 apply to the Truckee River; a similar variety of uses has been designated for tributary waters. In particular, all surface waters of these basins are designated for municipal and domestic supply (MUN) use, and all lakes and streams of the Truckee River basin are designated for “Rare, Threatened, or Endangered Species” use in recognition of the proposed reintroduction of the LCT to its original range. Beneficial uses would not change under the alternatives. Beneficial uses of surface water in the California portion of the study area (Lake Tahoe, Little Truckee, and Truckee River basins) include the following:

- Municipal and domestic supply
- Agricultural supply
- Ground water recharge
- Freshwater replenishment
- Water contact and non-contact recreation

- Cold freshwater habitat
- Wildlife habitat
- Hydropower generation (Truckee River and Little Truckee River basins only)
- Rare, threatened, or endangered species
- Migration of aquatic organisms
- Spawning, reproduction, and development
- Water quality enhancement
- Flood peak attenuation/flood water storage
- Industrial service supply (Truckee River basin only)
- Navigation (Lake Tahoe and Truckee River basins only)
- Commercial and sportfishing (Little Truckee River and Truckee River basins only)
- Preservation of biological habitats of special significance (Lake Tahoe basin only)

Beneficial uses of ground water in California include the following:

- Municipal and domestic supply
- Agricultural supply
- Industrial service supply

(In Nevada, beneficial uses in the Lake Tahoe and Truckee/Carson River basins include the following: irrigation; watering of livestock; contact and non-contact recreation; industrial supply; municipal and/or domestic supply; propagation of wildlife; propagation of aquatic life; enhancement of water quality (Lake Tahoe basin only); and water of extraordinary ecological or aesthetic value (Lake Tahoe basin only). Nevada State standards do not apply to Tribal lands.)

Applicable water quality objectives include region-wide objectives for parameters such as un-ionized ammonia, dissolved oxygen, taste and odor, pH, and pesticides. State drinking water maximum contaminant levels (MCL) for chemical constituents (including “priority pollutants”) and radioactivity apply to all waters designated MUN.

Waterbody-specific objectives have been adopted for constituents such as nutrients, TDS, and chloride. Most of these objectives have been set at monitored or modeled historic natural background levels, which generally reflect much higher quality than that needed to protect MUN use. The aquatic life uses of the Lake Tahoe and Truckee River basins reflect oligotrophic or nutrient poor conditions, and stringent nutrient objectives are needed to prevent eutrophication or nutrient rich conditions. Objectives for Lake Tahoe include the clarity and phytoplankton primary productivity levels measured between 1968 and 1971. Revised wastewater discharge requirements for the Truckee River downstream from TTSA leach fields are mass loading limitations and reflect effects of natural background quality. While lower than natural quality is allowed downstream from TTSA as a result of findings under the State nondegradation policy in 1980, TTSA has agreed to increase its level of nitrogen removal if objectionable levels of periphyton (attached algal growth) occur in this reach.

The Lahontan Basin Plan includes a regionwide narrative nondegradation objective which implements California State Water Resources Control Board (SWRCB) Resolution 68-16. This resolution provides that the quality of high-quality waters cannot be lowered unless findings are made that the degradation is of maximum benefit to the people of the State and that it will not reasonably affect present and anticipated beneficial uses. If degradation is permitted, quality cannot be lowered to less than levels required by water quality standards. The basin plan also includes a separate regionwide nondegradation objective for wetland communities and populations, which, among other things, provides, "All wetlands shall be free from activities that would substantially impair the biological community as it naturally occurs due to physical, chemical, and hydrologic processes."

For stream segments and water bodies that are not listed under section 303(d) (total maximum daily loads and individual water quality-based effluent limitations) of the Clean Water Act (40 CFR 130.7(b)), Federal antidegradation regulations provide that where lowering of water quality is permitted in exchange for socioeconomic benefits, beneficial uses must still be fully protected.

California water quality goals were used to identify potential water quality issues in the reaches of the Truckee River and tributaries located in California. Recent California water quality goals are summarized by Marshack (2003).

E. Truckee River Flow

The most important indicator of Truckee River water quality is flow, which affects all aspects of water quality, including dilution of wastewater treatment plant discharges. Low flows result in warming of the river and in near-stagnant water, while storms flush nutrients, organics, sediments, and poor quality water downstream.

1. Method of Analysis

Flows vary according to time of year, river location, and hydrologic condition. Therefore, flows (generated from the operations model) were compared in two representative months at three representative river locations in wet, median, dry, and very dry hydrologic conditions (10-, 50-, 90-, and 95-percent exceedences).

August was selected as the low-flow irrigation month and October as the low-flow non-irrigation month. Three river locations were evaluated: (1) upstream of TTSA, (2) downstream from TMWRF, and (3) the inflow point to Pyramid Lake. The first location incorporates the dilution downstream from the wastewater treatment facility in California. The second location incorporates the dilution just downstream from the major metropolitan Reno/Sparks area with warm temperatures and the reach with a DO "sag" due to decaying organics and algal growth from nutrients. Loadings to Pyramid Lake were calculated at the inflow point.

2. Threshold of Significance

In general, a 10-percent or greater difference in flow between the alternatives and current conditions or between the action alternatives and No Action was considered significant. The combination of errors such as instrumentation errors, flow data collection errors, data processing errors, and computation errors, have a 5- to 10-percent margin of error. However, relative differences among model results are more accurate and have less than a 5-percent margin of error.

3. Model Results

Table 3.18 presents operations model results for August and October flows at the three locations in wet, median, dry, and very dry hydrologic conditions.

4. Evaluation of Effects

a. No Action

Operations model results show that flows at the three locations are similar or higher under No Action than under current conditions, except upstream of TTSA in August in very dry hydrologic conditions, when flows may be 4 percent lower (24 cfs compared to 25 cfs). This difference is insignificant because it is within the margin of error of the model results.

Under No Action, flows downstream from TTSA should be sufficient during October in very dry hydrologic conditions to prevent poor water quality in California.

b. LWSA

Overall, water quality under LWSA would be about the same as under No Action and better than under current conditions, as shown by flow statistics. Higher flows than under current conditions would provide greater dilution of pollutants and increased habitat for biota.

c. TROA

Overall, operations model results show that water quality would be better under TROA than under No Action or current conditions because flows are higher and flow timing is more favorable. For example, flows downstream from TTSA in October in very dry hydrologic conditions under TROA are 21 cfs compared to 12 cfs under No Action, thereby providing additional dilution water for wastewater discharges. Also, TROA would provide the flexibility to rapidly flush the river to improve water quality.

F. Violations of Nevada Water Temperature and Dissolved Oxygen Standards

Truckee River water temperature is an important indicator of river water quality because it directly affects fish reproduction, growth, and survival. Warmer temperatures may stimulate production of biota, including algae, and decrease concentrations of DO, another important indicator of water quality. Extremely warm temperatures are detrimental to fish and biota.

Dissolved oxygen is required for respiration by aerobic life forms, such as fish, and for decay of organic matter, such as dead algae. Because the rate of biochemical reactions that use oxygen increases with increasing temperature, low DO concentrations in the Truckee River tend to be more critical in warm summer months. The problem is compounded in the summer because flows are usually lower and DO saturation is lower at higher temperatures. Therefore, the total possible quantity of oxygen available in the water is also lower.

1. Method of Analysis

Truckee River water temperature and DO concentrations vary according to reach and calendar year. Therefore, temperature and DO concentrations for the Truckee River reach from Lockwood, Nevada, to Derby Diversion Dam (generated from DSSAMt) were evaluated. This reach is downstream from two major tributaries, North Truckee Drain and Steamboat Creek, which contribute urban runoff and return flows from TMWRF. Lockwood is downstream from Reno (map 3.1), a major source of pollutants and organics, and in this reach, water quality constituents are completely mixed from bank to bank.

2. Threshold of Significance

An effect was considered significant if State standards were violated 5 days or more annually. Violation of a standard for as little as 1 hour was counted as 1 day, even though biota, in general, can tolerate poor water quality for such a brief period.

3. Model Results

Table 3.19 presents the annual total days that Nevada temperature and DO standards are violated in this reach in representative wet, median, and dry years, as shown by DSSAMt results.

4. Evaluation of Effects

a. No Action

DSSAMt results show that Nevada temperature standards are violated “significantly” in this reach in representative dry years under current conditions and No Action, although temperature violations occur more often under No Action than under current conditions.

Temperature violations also occur in representative wet and median years under current conditions and No Action.

DSSAMt results also show that Nevada DO standards are violated "significantly" in this reach in representative dry years under current conditions and No Action. Minimal DO violations occur in representative wet and median years. Violations occur less often under No Action than under current conditions, although low DO occurs in representative median and dry years under current conditions and No Action. (See Water Quality Appendix DSSAMt tables 1 through 12.)

b. LWSA

DSSAMt results show that water quality is about the same under LWSA as under No Action and better than under current conditions, as indicated by the number of days that Nevada temperature and DO standards are violated (table 3.19). In representative dry years, water temperatures are slightly cooler and DO concentrations are slightly higher under LWSA than under No Action. However, temperatures in representative dry years are warmer than under current conditions, and standards are met less often than under current conditions.

c. TROA

Overall, DSSAMt results show that Truckee River water quality is "significantly" better under TROA than under No Action or current conditions, as shown by the number of days that Nevada State temperature and DO standards are violated (table 3.19), especially in representative dry years.

In representative dry years, temperatures downstream from Reno are cooler and DO concentrations are higher under TROA than under No Action. In representative dry years, the higher flows push nutrients downstream quickly. As a result, standards are met more often. Model results show that Nevada State temperature standards are violated about as often in representative dry years under TROA as under current conditions.

DO standards are met more often in representative dry years under both TROA and No Action than under current conditions. As under No Action and LWSA, DO standards downstream from Reno are met more often under TROA than under current conditions, which is likely partly due to implementation of WQSA. However, almost no DO violations occur downstream from Reno in representative dry years under TROA partially because WQSA would be enhanced under TROA. Therefore, DO and overall water quality would be "significantly" better under TROA than under No Action and current conditions in most reaches of the Truckee River downstream from Reno in representative dry years.

G. Total Dissolved Solids and Nutrient Loadings to Pyramid Lake

Total dissolved solids (organic and inorganic material in solution with water), total nitrogen, and total phosphorus loadings to Pyramid Lake are indicators of Pyramid Lake water quality and indirect indicators of Truckee River quality.

Overall, DSSAMt results show that more flow and, therefore, slightly more TDS, reaches Pyramid Lake under TROA and the elevation (and, thus, volume) of Pyramid Lake increases. Total nitrogen and phosphorus loadings are about the same under TROA as under No Action and current conditions.

In general, most loadings to Pyramid Lake occur during large runoff events in wet years. In wet years, concentrations are typically low and water quality concentration standards are not violated often. In representative dry years, loadings to Pyramid Lake are minimal and water quality concentration standards in the lower Truckee River are violated frequently under both current and the alternatives because of low Truckee River flows and large diversions.

Total dissolved solids concentrations generally increase downstream and are an overall indicator of water quality degradation due to repeated water use. Likewise, the maximum TDS standards for river reaches increase downstream. Therefore, violations of TDS standards sometimes occur more frequently just downstream from where high TDS loadings from Steamboat Creek, North Truckee Drain, Helms Gravel Pit, and TMWRF discharge into the Truckee River. During low flows, TDS in the Truckee River downstream from Derby Diversion Dam frequently violates Nevada standards. High inflows contribute high TDS loadings to Pyramid Lake. Low flows, evaporation, and groundwater inflows with high concentrations results in high TDS concentrations in the lower Truckee River. Large inflows of relatively fresh water to Pyramid Lake decreases the Pyramid Lake TDS by dilution. Evaporation and low inflows to Pyramid Lake tends to increase its TDS.

Concerns of the Pyramid Tribe about violations of TDS standards have been relieved primarily due to recently installed BNR technology at TTSA which replaces the anion exchange technology. Anion exchange added total dissolved solids (salts) to the Truckee River. BNR has been included in the current and future alternatives. However, the loading from the TTSA wastewater treatment facility is comparably smaller than the loading from TMWRF and the Reno-Sparks metropolitan nonpoint sources.

Nutrients, such as nitrogen and phosphorus, are essential to the growth of algae and other plants and organisms in the Truckee River and Pyramid Lake. Thus, large nutrient loadings can stimulate excess algal growth and, consequently, organic matter decay. A majority of the total nitrogen reaching Pyramid Lake is organic nitrogen, which is not readily bioavailable for attached algae in the Truckee River. Once the organic nitrogen reaches Pyramid Lake, it has time to decay and can be used by green algae. Blue-green algae can produce excessive mats and reduce DO by respiration. At low nitrogen levels, blue-green algae can fix atmospheric nitrogen and grow more efficiently than the green algae, which become nitrogen-limited during summer and fall. Overall, more algal biomass due to more nutrient loading causes more decayable matter and less DO at the sediment water interface. The annual Pyramid Lake water quality model was run to determine if loading differences have a significant impact on Pyramid Lake water quality. Results of this model show little difference in Pyramid Lake water quality between the action alternatives and No Action or between any of the alternatives and current conditions.

1. Method of Analysis

The WARMF model used current and projected future land use to determine loadings from point and nonpoint sources. Output from the WARMF model was used as input to DSSAMt. TDS, total phosphorus, and total nitrogen loadings at the mouth of the Truckee River were used as water quality indicators and as partial input to the Pyramid Lake water quality model.

2. Threshold of Significance

In general, a 10-percent or greater difference in combined loadings between the alternatives and current conditions or between the action alternatives and No Action was considered significant. Model results have a 5- to 10-percent margin of error largely due to flow measurement errors of about 5 to 10 percent.

3. Model Results

Table 3.20 presents annual totals of TDS, total nitrogen, and total phosphorus loadings to Pyramid Lake in representative wet, median, and dry years, as shown by DSSAMt results.

4. Evaluation of Effects

a. No Action

Overall, DSSAMt model results show that Pyramid Lake water quality would be the same or slightly better under No Action than under current conditions. Specifically, water quality may be the same in representative wet and median years and slightly better in representative dry years under No Action, as shown by TDS, total nitrogen, and total phosphorus loadings to Pyramid Lake. Slightly less TDS loading would be transported to Pyramid Lake under No Action in representative median and dry years.

b. LWSA

Loadings to Pyramid Lake are about the same under LWSA as under No Action. Therefore, the effects on Pyramid Lake water quality also are expected to be about the same.

c. TROA

Overall, in representative wet years, Pyramid Lake water quality would be the same or better under TROA as under No Action, as shown by TDS, total nitrogen, and total phosphorus loadings to Pyramid Lake. In representative median and dry years, operations model results show that flow to Pyramid Lake is higher under TROA than under No Action, resulting in slightly more TDS loading to Pyramid Lake. However, the benefits of the additional flow and a higher Pyramid Lake elevation would outweigh the adverse effects of additional TDS. Loadings under TROA are similar to those under current conditions.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under TROA.

SEDIMENTATION AND EROSION

I. AFFECTED ENVIRONMENT

This section describes those aspects of sedimentation and erosion in the study area that could be affected by modifying operations of Truckee River reservoirs or that are of interest to the public or private agencies. Specifically, this section discusses shoreline erosion at Lake Tahoe, stream channel erosion and sediment transport in the Truckee River, and Truckee River delta formation at Pyramid Lake.

A. Shoreline Erosion at Lake Tahoe

Lake Tahoe has a surface area of 192 square miles and its watershed area is 314 square miles. The lake has an average water depth of 1027 feet, a maximum depth of 1646 feet, and about 71 miles of shoreline. The Federal Clean Water Act of 1972 designated Lake Tahoe as an "Outstanding Natural Resource." As such, no man-induced degradation of its water quality is allowed. SWRCB also adopted Resolution 68-16 that establishes a nondegradation policy for the protection of water quality, where waters are designated as high quality water, including Lake Tahoe (SWRCB, 1994). Lake Tahoe is identified as impaired under the Clean Water Act for nitrogen, phosphorus, and sedimentation/siltation. Total maximum daily load limits are being studied to identify load limits for the lake. It is considered an oligotrophic (low productivity) lake; that is, it still has relatively low concentrations of nitrogen and phosphorus.

Suspended sediment directly and indirectly affects Lake Tahoe water quality because the sediments carry nutrients into the lake. Reuter and Miller (2000) found that approximately 450 to 900 metric tons of sediment are introduced to the lake each year. Adams (2001) documented historic shoreline erosion using geographic information system (GIS) analysis. The total surface area of the eroded shoreline was estimated to be 32,000 square meters, or 429,000 metric tons, eroded between 1938 and 1998, an average of about 7,150 metric tons per year. This estimate of historical shoreline erosion is far more accurate than the amount predicted by Reuter and Miller (2000), because it was based on measurements of shoreline erosion from repeat aerial photography rather than a reasonable guess of the potential erosion rates.

Shoreline erosion is a result of many factors, including wave action, material properties of the shoreline, climate, and fluctuating water elevation. More specifically, shoreline erosion is typically caused by waves breaking at the base of easily eroded bluffs when the water elevation is high. Both the direct impact of waves on the bluffs and the onrush of waves up the beach are capable of erosion and sediment transport. When the water elevation is low, wave energy is expended on the beach and long-term shoreline erosion is reduced. (See the Sedimentation Appendix for a detailed discussion.)

1. Wave Action

The main mechanism of shoreline erosion is wave action caused by winds. Wave action is most damaging when (1) waves are high, (2) the water is high, i.e., between elevations 6227.0 and 6229.1 feet, the maximum managed elevation, (3) nearshore slope is steep, and (4) shoreline sediments are unconsolidated.

Another factor that affects wave action is runup, defined as the rush of water up a slope due to the breaking of a wave. Runup varies directly with wave height and inversely with foreshore slope. For gentle slopes, runup is greater because water moves further up the shore, reaching materials that otherwise would be undisturbed. The slope of the offshore lake bottom also affects wave action. The gentler the slope, the sooner the wave intersects the lake bottom, and the farther from shore the wave will break. In that case, wave energy is dissipated further from shore and has less effect on backshore erosion.

2. Material Properties of Shoreline

The eastern shore of Lake Tahoe contains granitic bedrock. The south shore consists mainly of glacial outwash, and the west shore is predominantly glacial moraines, outwash and lake deposits, although granitic bedrock is found at Rubicon Point. The north shore is comprised of volcanic rocks with some granites and many areas of alluvial and lake deposits. Thus, the south, west, and north shores are erodible (figure 3.26).

Orme (1972) thought that 16 percent of the Lake Tahoe shoreline is eroding. Osborne et al. (1985) concluded that (1) the principal sediment source of the major sand beaches at Lake Tahoe is the backshore erosion of lake and glacial outwash and (2) the major sediment source for the gravel and cobble is also erosion of the backshore areas and possibly nearshore erosion of lakebed deposits, moraines, and volcanic rocks. Sand is delivered to smaller beaches by weathering of granite bedrock and boulders.

Unconsolidated sediments that may contribute to lake degradation have three predominant sources: (1) foreshore, (2) backshore, and (3) nearshore. Foreshore is the zone of lake elevation fluctuation, or the area between high and low water surface elevations. At Lake Tahoe, the zone of fluctuation is between elevation 6229.1 and 6223.0 feet (a height of 6.1 feet). Backshore, where the water meets the land, is the zone of instability. The lakeward limit of the backshore is the high water elevation. Nearshore is the zone that extends from the low water elevation of 6223.0 feet down 30 feet to a lake bed elevation of 6193.0 feet (TRPA, 1995).

Unconsolidated sediments (of which sand and finer grained particles are the most easily transported) in the foreshore and nearshore can become entrained because of wave action. These sediments either can be deposited on the shore or can drift out into the lake. Such movement of sediments into the lake is not considered in the evaluation. Sediment in the

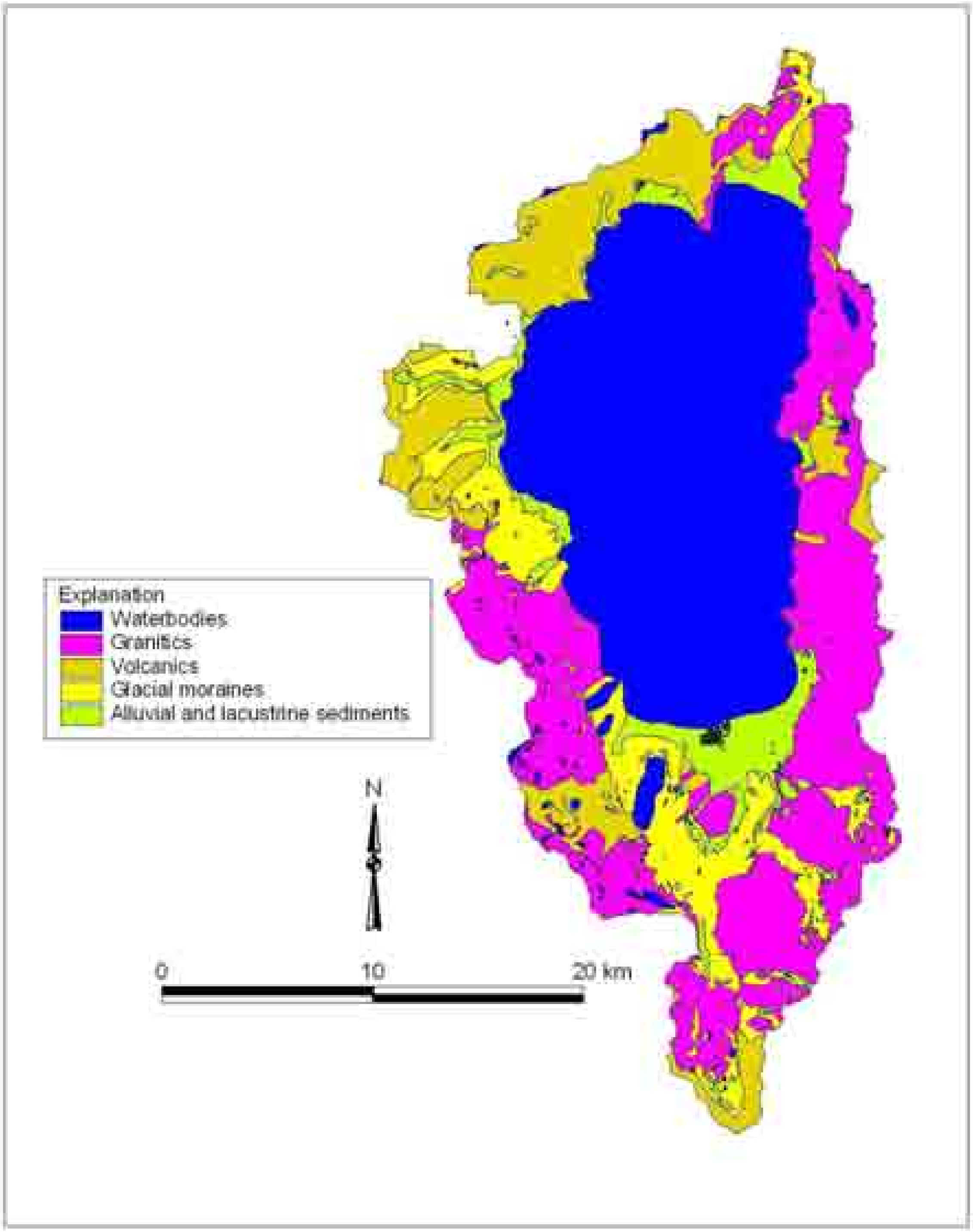


Figure 3.26.—Generalized geology map of Lake Tahoe (Adams, 2003).

foreshore is continually exposed to wave action in the normal operating range of Lake Tahoe (elevation 6223.0 to 6229.1 feet). That is, sediment continually moves back and forth between the lake and the shore at all lake elevations. These movements are the same regardless of operations (Adams, 2003).

Sediments from the backshore could erode and move into the lake if its elevation were comparatively higher. Such erosion could be possible when the elevation of the lake is between 6227 and 6229.1 feet. The greatest potential for erosion events occurs when strong winds blow across the lake and the lake water elevation is at maximum (Adams, 2001). At such high elevations, more unconsolidated sediments are accessible to wave erosion within the backshore. At lower elevations, finer, smaller sediments have already been eroded from the shore surface, leaving gravels, cobbles, and bedrock as armor against additional erosion.

3. Climate

The climate of the Lake Tahoe basin is also important to shoreline erosion. The lake is generally higher during the late winter, spring, and summer. Erosion of the lake occurs more frequently during late winter and spring months when strong winds blow across the lake when the elevation is 6627 feet or greater.

4. Fluctuating Water Elevation

Another important factor to shoreline erosion at Lake Tahoe is seiche, which is a periodic oscillation of the water body. Seiches can temporarily raise water elevation along a shore, allowing waves to go further inland. LeConte (1884) estimated that the period of a seiche at Lake Tahoe is 17 minutes in a north-south direction and 10 minutes in an east-west direction.

B. Stream Channel Erosion and Sediment Transport

Stream channel erosion occurs along some reaches of steams in the Truckee River basin, although most streams in the basin are well armored and experience little erosion. Background data on normalized average annual sediment loads in the Truckee River are presented in figure 3.27 for several sub-watersheds. The basins with the highest annual suspended sediment load include Bear, Squaw, Donner and Gray Creek watersheds. These watersheds show high rates of suspended sediment load either because of rapid urbanization or naturally occurring high erosion rates, as in Gray Creek.

The following areas within the study area have the greatest potential for erosion and sediment transport.

The Upper Truckee River is the largest stream tributary to Lake Tahoe in terms of flow and watershed size, and it may deliver some of the largest nutrient and sediment loads to the lake. The watershed was severely disturbed in the 19th and early 20th centuries by logging and grazing, and in the later 20th century by urban development. Lake Tahoe and several of its tributaries are listed for sediment under section 303(d) of the Clean Water Act. Sediment loading from Lake Tahoe and its tributaries is being considered for TMDL development for

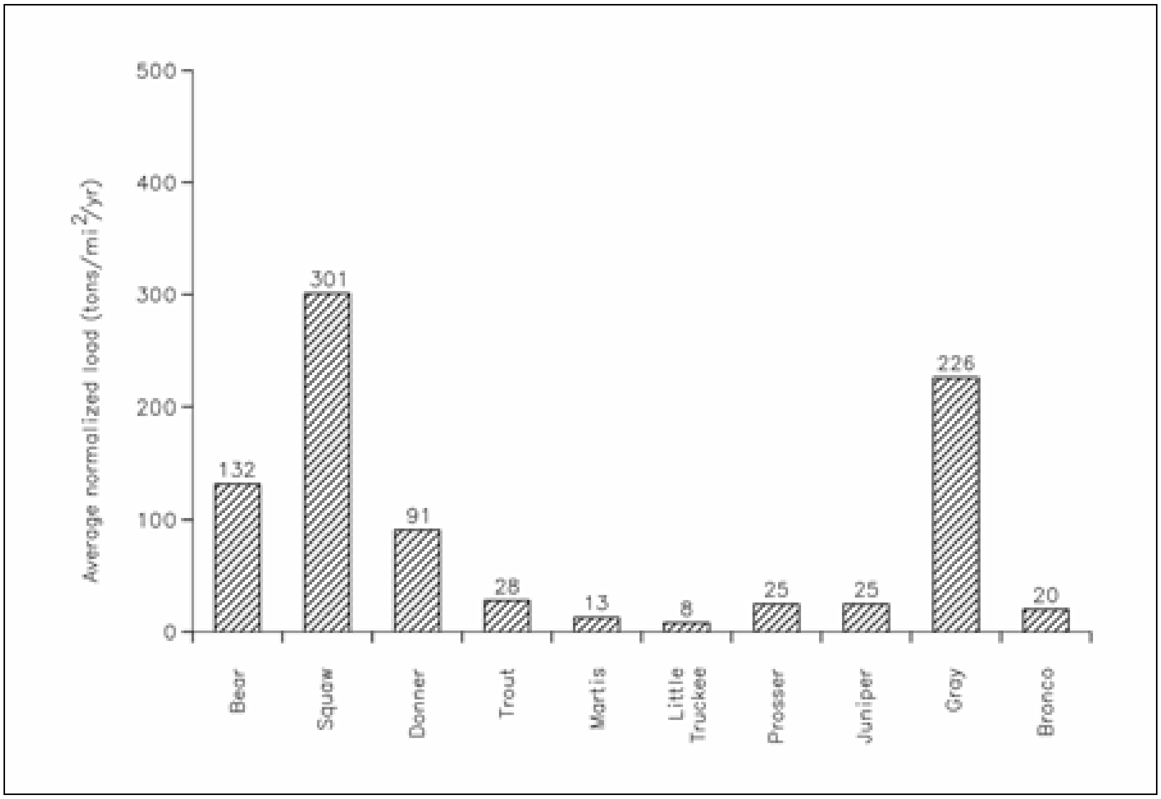


Figure 3.27.—Average annual suspended sediment load normalized by area (McGraw et al., 2002).

Lake Tahoe. The Upper Truckee River is currently identified as impaired for sediments and nutrients under section 303(d). The Lake Tahoe Watershed Assessment gave the river an Aquatic Ecosystem Rating of "imperiled" (SWRCB, 2002).

The Trout Creek watershed, east of the Upper Truckee River watershed, is the second largest watershed in the Lake Tahoe basin, with an area of 41.2 square miles. Slopes range from nearly flat to 50 percent at higher elevations. The watershed has been disturbed by historic logging and livestock grazing, ski resort development in the Heavenly Valley Creek watershed, and urban development near Lake Tahoe. Heavenly Valley Creek, a tributary of Trout Creek, is considered impaired for sediments under section 303(d) of the Clean Water Act (SWRCB, 2002). TMDL guidelines are being prepared for Heavenly Valley Creek.

Ward Creek, a tributary to Lake Tahoe on its western shore, is near the community of Sunnyside. It has a watershed area of about 10 square miles and a main channel length of about 6 miles. In addition to the development near its mouth, the Alpine Peaks subdivision and roads and lifts from the Alpine Meadows ski resort are located in the Ward Creek and Bear Creek watersheds. (Bear Creek watershed is in the Truckee River basin.) It also is considered impaired for sediments under section 303(d) (SWRCB, 2002).

Squaw Creek, a tributary to the Truckee River, also is considered impaired for sediments under section 303(d). The ski resort and the construction during the 1960 Winter Olympics, including channelization, have greatly affected the water quality of the creek. The lower creek has high bedload sediment transport, and the creek is considered impaired for sediment. (SWRCB, 2002)

The Truckee River from Lake Tahoe to the Nevada State line and some of its tributaries are considered impaired for sediments. Two watersheds with highly erosive drainages are also considered impaired: Bronco Creek and Gray Creek. Donner Lake is also considered impaired for organics under section 303(d). Additional information is presented in Chapter 4, "Cumulative Effects." The creeks are underlain by large areas of volcaniclastic rocks and are considered to be highly erosive. These watersheds also have steep valley side slopes and large gradients in the lower part of each watershed, which also make these watersheds very erosive (McGraw et al., 2001).

The potential for erosion in the Truckee River basin is based on the combined effects of precipitation, slopes, and soil types. Soils on 0- to 5-percent slopes are at the southern end of Lake Tahoe, in Martis Valley in the Little Truckee River basin, and in Truckee Meadows. These soils areas are glacial and alluvial outwash and represent 8 percent of the Truckee River basin area upstream of Reno.

Approximately 15 percent of the Truckee River basin area is located on 5- to15-percent slopes on glacial outwash and terraces and alluvial fans. These soils have moderate erosion. Areas with 15- to 30-percent slopes, which make up 15 percent of the watershed—primarily in the Little Truckee, Prosser and Donner Creek basins—are primarily mountain slopes, moraines, and upland ridges. These soils have moderate erosion. On 30- to 50-percent slopes, which comprise 42 percent of the Upper Truckee River basin area, are mountain slopes and outwash moraine. These soils have moderate erosion. About 2.5 percent of the area is on slopes greater than 50 percent, which are canyon side slopes in headwaters of Donner Creek and along the Truckee River canyon north of Farad. These soils have high to severe erosion.

The potential for erosion is greatest in the Truckee River canyon. The highest sediment yield areas of the basin are the Gray Creek watershed and the upper portion of Bronco Creek. The second highest sediment yield area of the watershed is Dog Valley and the contiguous mountain slopes to the east. Erosion also occurs in Washoe County but is not a major problem. Soils in Truckee Meadows are susceptible to erosion and can erode quickly when they are subject to heavy water flow. Occasional landslides occur along the Truckee River and have developed on slopes near Mogul, probably because of river erosion (Westpac Utilities, 1990). High turbidities have been observed on Bronco Creek and Gray Creek during storms where these tributaries enter the Truckee River upstream of Floriston, also an indication of erosion.

The Little Truckee River between Stampede Dam and Boca Reservoir could be affected by changes in flow resulting from modifying reservoir operations. Changes in flow could increase erosion and the accumulation of sediment into Boca Reservoir. If this were to occur, fish habitat between Stampede Dam and Boca Reservoir could deteriorate. However, a field investigation of this reach revealed little evidence of channel instability resulting in bank and channel erosion. Also, aerial photos taken in 1972 and 1992 were compared to assess changes in channel width and shape. Only normal changes were identified.

The Newlands Project and channel modifications have influenced sedimentation of the Truckee River from Reno to Pyramid Lake. The lowering of Pyramid Lake caused base-level lowering of the Truckee River. The lower-most reaches of the Truckee River incised in response to the base-level lowering. The high sediment loads carried by the lower Truckee River greatly accelerated the creation of the Truckee River delta. Channel incision from Numana Dam to Pyramid Lake has resulted in unstable banks and loss of riparian habitat.

Many sediment-related problems exist in the Truckee River from Derby Diversion Dam to Pyramid Lake, including scouring of the riverbed in the lower channel. Bank erosion caused by high flows is severe in much of the river downstream from Wadsworth. During long periods of low flow, new flood plains and river channels develop. These areas, which are narrower and less defined than historically, generally do not have the capacity to control large flood events. During floods, extensive erosion and migration of these new channels (the gradual change of channel course) occur. In general, higher flows result in greater sediment transport capability and, therefore, changes in erosion and deposition patterns. Sediment erosion and transport are greatest during floods that follow prolonged periods of low flows.

C. Truckee River Delta Formation at Pyramid Lake

At the point of inflow, the Truckee River currently is building a delta northward into Pyramid Lake. (A delta is a deposit, partly on the land surface, built by a river flowing into an estuary, lake, or reservoir.) At times, the river channel through the delta is shallow, braided, and poorly defined, and upriver passage of cui-ui and LCT during the spawning season is impeded or precluded. Also, fish attempting to pass through the delta are easy prey for white pelicans.

Decreased inflow caused the elevation of Pyramid Lake from 3870 feet in 1910 to 3796 feet in 1994 (observed data). The decline has led to erosion and headcutting upstream of Pyramid Lake, which, in turn, has resulted in channel degradation and incision of a pre-existing delta complex between Pyramid Lake and Nixon. Headcutting is the sudden change in elevation or knickpoint at the leading edge of a gully. Headcuts can range from less than an inch to several feet high, depending on several factors. Consequently, substantial amounts of locally eroded sediment are added to the normal sediment load of the Truckee River. Deposition of this combined sediment load has formed the delta at the mouth of the Truckee River. This locally eroded sediment was greatly reduced after construction of Marble Bluff Dam in 1975, which controlled upstream headcutting. The delta is about 4,000 feet wide at the mouth, 2,500 feet wide at the head, and about 13,000 feet long.

Change in areal extent of the delta depends on the interaction of several factors:
(1) fluctuation pattern of lake elevation, (2) upstream erosion, and (3) the amount of sediment inflow. As water elevation decreases, more of the existing delta becomes exposed. However, a water elevation decrease changes the hydraulic conditions at the river/lake confluence. More specifically, a decrease causes a drawdown effect, resulting in higher water velocities, increased erosion, and, thus, movement of the delta farther downstream into the lake. An increase in average lake elevation will have the opposite effect. Initially, the areal extent of exposed delta will decrease as it is submerged. But the increased water

elevation will cause a backwater effect, resulting in lower water velocities, increased deposition further upstream, and movement of the delta farther upstream into the river channel.

In general, increased upstream erosion and, thus, sediment inflow to the lake, will increase the areal extent of the delta. Decreased upstream erosion and sediment inflow will have the opposite effect.

Flows entering Pyramid Lake carry sediment of varying concentrations. Because the lake has no outlet, all sediments entering Pyramid Lake are deposited there. The coarsest sediment particles (sand and gravels) entering the lake deposit first and form the Truckee River delta. Finer sediment particles (silt and clay) are transported further in the lake and deposit in deeper water.

D. Carson River

Before construction of the Newlands Project, flows in the Carson River were subject to sudden and dramatic changes. Uncontrolled spring runoff temporarily inundated large sections of Lahontan Valley, supporting wetland habitats. During these large seasonal events, sediment load would also increase and deposit in wetland areas.

The natural hydrologic cycle of the Carson River downstream from Lahontan Reservoir (lower Carson River) has been completely altered. Most flow in the lower Carson River occurs during the irrigation season, from April through September, with the maximum flows in May and June. Thus, the greatest potential for erosion of the lower Carson River also is in these months. The greatest likelihood of erosion is during avection thunderstorm floods (when a large spring or summer rainfall event occurs with snow still on the ground; because the rain cannot infiltrate the snow-covered ground, it runs off quickly, causing extreme flooding). However, the lower Carson River does not currently cause much sedimentation or erosion because the water from the river is routed through 381 miles of canals and laterals (FWS, 1996). Substantial streambank erosion did occur in the upper Carson River during the January 1997 flood event. Operations of the Truckee River under TROA would have little effect on the dynamics of sedimentation or erosion at Lahontan Dam and Reservoir and the lower Carson River and, thus, are not discussed in “Environmental Consequences.”

II. Environmental Consequences

Modifying operations of Truckee River reservoirs could affect the elevations of lakes and reservoirs and the quality, quantity, timing, and duration of flows. Changes in elevation at Lake Tahoe, when combined with wind-induced waves, could affect shoreline erosion. Increased flows over a long period or during a short-duration flood event could cause riverbanks or channel beds to erode at an increased rate. Some of the sediment load resulting from this erosion could be deposited in less steep reaches downstream, which could damage fish habitat, decrease channel capacity, and increase Truckee River delta growth. Conversely, decreased flows could cause increased sediment deposition, which could decrease channel capacity and foul gravels used as fish spawning beds.

A. Introduction

This analysis evaluated the effects of changes in water elevation and flows on sedimentation and erosion using following the indicators:

1. Shoreline erosion at Lake Tahoe, as measured by Lake Tahoe water surface elevation.

2. Stream channel erosion and sediment transport capacity change in five representative reaches of the Truckee River, as measured by flow.

3. Truckee River delta formation at Pyramid Lake, as measured by water surface elevation change and inflow to Pyramid Lake.

The following sections describe the indicators and the methods used to analyze them. Data used in the analyses include water surface elevations, reservoir releases, flows, and inflow to Pyramid Lake generated from the operations model.

B. Summary of Effects

Analysis of operations model results, in general, shows the following:

No increased shoreline erosion at Lake Tahoe would occur under No Action, LWSA, or TROA; water quality would not be degraded; and the maximum elevation at which the lake is currently operated would not be exceeded.

Erosion and sediment transport in the Truckee River from Donner Creek to the Little Truckee River confluence would not differ significantly under any alternative.

In the Little Truckee River from Stampede Dam to Boca Reservoir, potentially more erosion could occur under No Action and LWSA than under current conditions. Under TROA, the potential for more sediment deposition could exist. However, because the reach is located downstream from Stampede Reservoir and is currently armored, sediment transport and erosion would not be affected. In the Spice and Lockwood reaches of the Truckee River, the potential for more sediment deposition could exist under No Action and LWSA than under current conditions. However, because no known sediment sources affect the Spice reach, sediment transport and erosion in this reach would not be affected. In the Lockwood reach, Steamboat Creek is an important potential source of sediment that could cause some increase in deposition. Very little change in erosion and sediment transport would occur under TROA because sediment transport capacity change does not vary significantly from current conditions.

In the Nixon reach, less erosion and sediment transport likely would occur under No Action and LWSA than under current conditions. With greater average annual flow, slightly more sediment transport could occur under TROA, but the effect would not be significant.

Truckee River delta dynamics would not be affected under TROA or the other alternatives.

Table 3.21 summarizes the effects of the alternatives on sedimentation and erosion.

Table 3.21.—Summary of effects on sedimentation and erosion

Indicator	No Action	LWSA	TROA
Shoreline erosion at Lake Tahoe	No man-induced degradation of any water quality parameters.	Same as under No Action.	Same as under No Action.
Stream channel erosion and sediment transport capacity change	Truckee River from Donner Creek to the Little Truckee River confluence: same as or less than under current conditions. Little Truckee River from Stampede Dam to Boca Reservoir: same as under current conditions. Spice: about the same as under current conditions. Lockwood: less sediment transport and more deposition than under current conditions. Nixon: about the same as under current conditions.	Truckee River from Donner Creek to the Little Truckee River confluence: same as under No Action. Little Truckee River from Stampede Dam to Boca Reservoir: same as under No Action. Spice: same as under No Action. Lockwood: Same as under No Action. Nixon reach: same as under No Action.	Truckee River from Donner Creek to the Little Truckee River confluence: about the same as under No Action. Little Truckee River from Stampede Dam to Boca Reservoir: no overall effect. Spice: no overall effect. Lockwood: same as under current conditions; no overall effect compared to No Action. Nixon reach: no overall effect.
Truckee River delta dynamics at Pyramid Lake	Same as under current conditions.	Same as under No Action.	Same as under No Action.

C. Shoreline Erosion at Lake Tahoe

1. Method of Analysis

Shoreline erosion at Lake Tahoe was evaluated by comparing the end-of-month water surface elevations of Lake Tahoe in very wet (5-percent exceedence) and median (50-percent exceedence) hydrologic conditions under current conditions and the alternatives. Elevations were generated from the operations model. Very wet, rather than wet, hydrologic conditions were analyzed because the lake would be higher in these hydrologic conditions; thus, shoreline erosion would be more likely to occur. Water surface elevations in dry hydrologic conditions would be too low to affect shoreline erosion.

An increase in elevation, if significant, could potentially increase shoreline erosion by exposing more fine sediment of the backshore area to wave erosion. Based on studies by Adams (2001), the potential for shoreline erosion at Lake Tahoe exists when the lake is between elevation 6627 and 6629 feet.

2. Threshold of Significance

An effect on shoreline erosion at Lake Tahoe was considered significant if the water surface elevation were at least 0.25 foot higher, on a monthly basis, under the alternatives than under current conditions or under the action alternatives than under No Action. This threshold of significance is thought to produce a measurable increase in shoreline erosion and was developed on the basis of professional judgment. (See the Sedimentation and Erosion Appendix for a detailed explanation of this analysis.)

3. Model Results

Table 3.22 presents operations model results for end-of-month water surface elevations in Lake Tahoe in very wet and median hydrologic conditions.

4. Evaluation of Effects

a. No Action

Operations model results show that Lake Tahoe exceeds elevation 6627 feet, the threshold for potential shoreline erosion, in very wet hydrologic conditions under both No Action and current conditions. However, the lake is slightly higher in November, December, January, August, and September under No Action than under current conditions. In median hydrologic conditions, elevations from January through September exceed the threshold. However, none of the differences between No Action and current conditions are greater than 0.25 foot, the threshold of significance. On the basis of these results, the potential for shoreline erosion under No Action is essentially the same as under current conditions.

b. LWSA

In both very wet and median hydrologic conditions, Lake Tahoe’s end-of-month elevations are about the same under LWSA and No Action; thus the potential for shoreline erosion would be the same. Elevations are slightly higher from November through January under LWSA than under current conditions and are almost the same in other months. Any differences are so small that no increase in shoreline erosion is expected.

c. TROA

In very wet hydrologic conditions, Lake Tahoe’s end-of-month elevations do not differ by more than 0.08 foot among TROA, No Action, or current conditions. Thus, no increase in shoreline erosion is expected, and there would be no degradation of water quality under any alternative. In median hydrologic conditions, Lake Tahoe’s elevation exceeds 6627 feet in all months under TROA, compared to only the months of October, November, and December under current conditions. However, the differences are not greater than 0.18 foot. Likewise, Lake Tahoe’s elevation does not differ by more than 0.21 foot between TROA and No Action. Therefore, no increase in shoreline erosion is expected under TROA.

Table 3.22.—End-of-month water surface elevations of Lake Tahoe (msl)

Month	Current conditions	No Action	LWSA	TROA
Very wet hydrologic conditions				
October	6228.40	6228.37	6228.37	6228.36
November	6228.22	6228.30	6228.30	6228.28
December	6228.30	6228.34	6228.34	6228.34
January	6228.41	6228.44	6228.44	6228.45
February	6228.49	6228.49	6228.49	6228.51
March	6228.65	6228.65	6228.65	6228.69
April	6228.75	6228.75	6228.75	6228.75
May	6229.00	6229.00	6229.00	6229.00
June	6229.00	6229.00	6229.00	6229.00
July	6229.00	6229.00	6229.00	6229.00
August	6228.78	6228.79	6228.79	6228.77
September	6228.50	6228.51	6228.51	6228.50
Median hydrologic conditions				
October	6226.98	6226.99	6226.98	6227.16
November	6226.98	6226.94	6226.94	6227.15
December	6226.96	6226.91	6226.91	6227.12
January	6227.31	6227.21	6227.21	6227.31
February	6227.32	6227.25	6227.25	6227.39
March	6227.37	6227.34	6227.33	6227.41
April	6227.42	6227.40	6227.40	6227.52
May	6228.07	6228.07	6228.07	6228.11
June	6228.55	6228.49	6228.48	6228.52
July	6228.34	6228.30	6228.30	6228.33
August	6227.98	6227.94	6227.94	6227.96
September	6227.57	6227.52	6227.52	6227.61

In median hydrologic conditions, the three water surface elevation comparisons show differences in proportions of affected shoreline angles (Adams, 2003). Water surface elevations are about .013 feet to 0.17 foot higher under TROA than under No Action and current conditions. Under TROA, approximately 84 to 91 percent of the measured shoreline angles and beach ridges would not be affected. Under No Action and current conditions, 90 to 96 percent of the sites would not be affected. Obviously, the number of sites affected differs among the three comparisons, but the difference is not considered statistically significant. Adams (2003), therefore, concludes that implementing TROA would have no measurable effects on the shoreline erosion at Lake Tahoe and would not result in any man-induced degradation of the water quality.

Consequently, because TROA would not have a measurable effect on sedimentation in Lake Tahoe, TROA would not have an adverse effect on existing beneficial uses associated with

Lake Tahoe, or affect the attainment of California or Nevada water quality objectives for sedimentation.

5. Mitigation

No mitigation would be required because no man-induced degradation of the water quality of Lake Tahoe and no measurable changes in shoreline erosion would occur under any of the alternatives. The maximum water surface elevation at which the lake is currently operated would never be exceeded under any alternative. Any other changes in shoreline erosion are not measurable; therefore, no change in shoreline erosion is expected. Lake Tahoe is an Outstanding Natural Resource Water. Reservoir operations under TROA would not adversely affect the non-degradation objectives developed to maintain the outstanding qualities of Lake Tahoe.

D. Stream Channel Erosion and Sediment Transport

1. Method of Analysis

The difference in sediment transport capacity change in five reaches of river was evaluated using average monthly flows in very wet and median hydrologic conditions, generated from the operations model. Sediment transport capacity change was computed as a function of flow (raised to the second or third power). Median and very wet hydrologic conditions were analyzed because flows in these conditions could significantly affect sediment transport capacity. Higher average monthly flows (assuming that the variability in daily flows within a month does not change) would result in greater change in sediment transport capacity and, potentially, greater erosion of the river channel.

2. Threshold of Significance

For stream channel erosion and sediment transport, an effect was considered significant if it would cause widespread and measurable channel erosion or deposition. Based on professional judgment, widespread and measurable channel erosion is expected to occur under the alternatives when sediment transport capacity change is more than 10 percent greater than under current conditions, and the streambed is not already armored. Widespread and measurable channel deposition is expected when sediment transport capacity change is more than 10 percent less than under current conditions and there is a substantial upstream source of river or tributary sediment. For example, a channel downstream from a dam would not have an upstream source of sediment and the bed material sediments would be armored (not erodible). A decrease in sediment transport capacity change for a river downstream from a dam would not result in deposition without a large source of tributary sediment.

The following reaches were evaluated because they are considered representative of the entire river. Map 3.1 shows the locations of the reaches.

Truckee River: Donner Creek to Little Truckee River confluence
Little Truckee River: Stampede Dam to Boca Reservoir

Truckee River: Reno-Sparks to McCarran Boulevard (Spice)
Truckee River: McCarran Boulevard to Derby Diversion Dam (Lockwood)
Truckee River: Derby Diversion Dam to Pyramid Lake (Nixon)

3. Model Results

Table 3.23 presents weighted average differences in sediment transport capacity change for the five river reaches in very wet and median hydrologic conditions.

4. Evaluation of Effects

a. No Action

i. Truckee River: Donner Creek to Little Truckee River Confluence

Operations model results show that annual sediment transport capacity change is 7 to 10 percent less under No Action than under current conditions in very wet hydrologic conditions and 3 to 5 percent less in median hydrologic conditions. On a monthly basis, sediment transport capacity is greater in median hydrologic conditions under No Action, except from March through May, when is it is less than under current conditions. Based on these results, erosion and sediment transport in this reach likely would be the same or less under No Action as under current conditions.

ii. Little Truckee River: Stampede Dam to Boca Reservoir

Annual sediment transport capacity change is about 1 to 2 percent greater under No Action than under current conditions in very wet hydrologic conditions and 6 to 13 percent greater in median hydrologic conditions. On a monthly basis, sediment transport capacity change in median hydrologic conditions is less in January and March and from July through September under No Action than under current conditions. Sediment transport capacity change is greater in the other months. Annual sediment capacity change is more than 10 percent greater under No Action; thus, more erosion and sediment transport likely could occur in this reach, but because this reach is located downstream from a dam and the river is armored, very little change in sediment transport is expected.

iii. Spice

Annual sediment transport capacity change is 7 to 10 percent less under No Action than under current conditions in very wet hydrologic conditions and 18 to 25 percent less in median hydrologic conditions. More sediment deposition could occur in this reach under No Action than under current conditions, but because a source of sediment likely does not exist upstream, substantial deposition is not likely.

Table 3.23.—Weighted average differences in sediment transport capacity change

	No Action, compared to:	LWSA, compared to:		TROA, compared to:	
	Current Conditions	Current Conditions	No Action	Current Conditions	No Action
Very wet hydrologic conditions					
Truckee River: Donner Creek to Little Truckee River Confluence	7 to 10% less; potential for some deposition	2 to 3% less; no change	No change	2 to 4% greater; no change	4 to 7% greater; potential for some deposition
Little Truckee River: Stampede Dam to Boca Reservoir	7 to 10% less; potential for some deposition	2 to 3% less; not change	0 to 1% greater; no change	8 to 11% greater; potential for more erosion	7 to 10% greater potential for more erosion
Spice	7 to 10% less; potential for some deposition	7 to 11% less: potential for some deposition	0 to 1% less; no effect	1 to 2% greater; no change	8 to 13% greater; some erosion
Lockwood	3 to 6% less; very little deposition	4 to 6% less: very little deposition	0 to 1% less; no change	3 to 5% greater; no change	7 to 11% greater; some change
Nixon	3 to 6% less; very little deposition	3 to 5% less; very little deposition	No change	3 to 5% less; no change	7 to 11% greater; some erosion
Median hydrologic conditions					
Truckee River: Donner Creek to Little Truckee River Confluence	3 to 5% less; very little deposition	3 to 5% less; very little deposition	No change	3 less to 3% greater; no change	0 to 9% greater; potential for erosion
Little Truckee River: Stampede Dam to Boca Reservoir	6 to 13% greater; potential for more deposition	6 to 14% greater; potential for more deposition	0 to 1% greater; no change	15 to 24% less; potential for deposition	20 to 33% less; potential for more deposition
Spice	18 to 25% less; potential for more depostion	11 to 25% less; potential for more deposition	0 to 1% greater; no change	9 to 11% less; potential for some deposition	9 to 21% greater; potential for erosion
Lockwood	11 to 17% less; more deposition	11 to 17% less; more deposition	0 to 1% greater; no change	3 to 5% less; no change	7 to 17% greater; potential for erosion
Nixon	6 to 11% less; potential for more deposition	7 to 11% less; potential for more deposition	0 to 1% greater; no change	2 to 5% less; no change	2 to 9% greater; potential for some erosion

iv. Lockwood

Annual sediment transport capacity change is 3 to 6 percent less under No Action than under current conditions in very wet hydrologic conditions and about 11 to 17 percent less in median hydrologic conditions. In median hydrologic conditions, monthly sediment capacity change is less in every month than under current conditions. Thus, much less sediment transport likely would occur in this reach under No Action than under current conditions, and substantial deposition is possible. Steamboat Creek is a potential source of sediment within this reach.

v. Nixon

Annual sediment transport capacity change is about 3 to 5 percent less under No Action than under current conditions in very wet hydrologic conditions and about 6 to 11 percent less in median hydrologic conditions. Monthly sediment transport capacity change in median hydrologic conditions is less under No Action than under current conditions from November through June, and greater in August and September. These results suggest that sediment transport in this reach likely would be less under No Action than under current conditions, and sediment deposition is possible. However, a source of sediment likely does not exist upstream, so significant deposition is not likely.

b. LWSA

i. Truckee River: Donner Creek to Little Truckee River Confluence

Annual and monthly sediment transport capacities are the same under LWSA and No Action; thus, erosion and sediment transport in this reach likely would be the same under LWSA as under No Action.

Operations model results show that annual sediment transport capacity change is 2 to 3 percent less under LWSA than under current conditions in very wet hydrologic conditions and 3 to 5 percent less in median hydrologic conditions. In median hydrologic conditions, monthly sediment transport capacity change is less under LWSA than under current conditions in December and from March through June.

ii. Little Truckee River: Stampede Dam to Boca Reservoir

Annual sediment transport capacity change is only 1 percent or less under LWSA than under No Action in both wet and median hydrologic conditions, which suggest that erosion and sediment transport in this reach likely would be almost the same under LWSA and No Action.

Annual sediment transport capacity change is about 1 to 2 percent greater under LWSA than under current conditions in very wet hydrologic conditions and 6 to 14 percent greater in median hydrologic conditions. On a monthly basis, in median hydrologic conditions, sediment transport capacity change is less in January, March, and from July through September under LWSA than under current conditions. In the remaining months, sediment transport capacity change is greater. Annual sediment capacity change is more than 10 percent greater under LWSA than under current conditions. Therefore, significantly more erosion and sediment transport could occur in this reach under LWSA than under current conditions, but because this reach is downstream from a dam and the river is armored, very little change is expected.

iii. Spice

Annual sediment transport capacity change is essentially the same in very wet hydrologic conditions and about 1 percent less in median hydrologic conditions under LWSA than under No Action. On a monthly basis, sediment transport capacity change is almost identical under both alternatives throughout the year. These results suggest that erosion and sediment transport in this reach likely would be the same under LWSA as under No Action.

Annual sediment transport capacity change is 7 to 11 percent less under LWSA than under current conditions in very wet hydrologic conditions and 18 to 25 percent less in median hydrologic conditions. Monthly sediment capacity in median hydrologic conditions is less under LWSA than under current conditions in all months except September and October. Thus, sediment transport in this reach likely would be less under LWSA than under current conditions, and substantial sediment deposition is possible. However, a source of sediment does not exist upstream, so significant deposition is not likely.

iv. Lockwood

Annual and monthly sediment transport capacity change is nearly the same under LWSA as under No Action, which suggests that erosion and sediment transport in this reach would be the same under LWSA as under No Action.

Annual sediment transport capacity change is 4 to 6 percent less under LWSA than under current conditions in very wet hydrologic conditions and 11 to 17 percent less in median hydrologic conditions. On a monthly basis, sediment transport capacity change in median conditions is less in all months, except October, under LWSA than under current conditions. Thus, less sediment transport likely would occur in this reach under LWSA than under current conditions, and substantial sediment deposition is possible. Steamboat Creek is a potential source of sediment within this reach.

v. Nixon

Annual sediment transport capacity change is about the same under LWSA as under No Action, suggesting that erosion and sediment transport in this reach likely would be the same under LWSA as under No Action.

Annual sediment transport capacity change is 3 to 5 percent less under LWSA than under current conditions in very wet hydrologic conditions and 7 to 11 percent less in median hydrologic conditions. On a monthly basis, sediment transport capacity change in median conditions is less from November through May and much greater in August, September, and October under LWSA than under current conditions. These results suggest that less sediment transport likely would occur in this reach under LWSA than under current conditions and some sediment deposition is possible. However, a source of sediment probably does not exist upstream, so significant deposition is not likely.

c. TROA

i. Truckee River: Donner Creek to Little Truckee River Confluence

Annual sediment transport capacity change is 4 to 7 percent greater under TROA than under No Action in wet hydrologic conditions and 0 to 9 percent greater in median hydrologic conditions. On a monthly basis, sediment transport capacity change in median conditions is less from October through March and in September and much greater from April through August under TROA than under No Action. Thus, more erosion and sediment transport likely would occur in this reach under TROA than under No Action, but because the change is less than 4 percent from current conditions, the effect would not be significant.

Annual sediment transport capacity change is 2 to 4 percent greater under TROA than under current conditions in very wet hydrologic conditions and no more than 3 percent greater in median hydrologic conditions. Monthly sediment transport capacity change in median hydrologic conditions is less from October through April and in September and much greater from May through August under TROA than under current conditions. These results suggest that erosion and sediment transport in this reach likely would be almost the same under TROA and current conditions. Erosion and sediment transport in this reach under TROA would be similar to current conditions. Consequently, TROA is not expected to impair the attainment of water quality objectives or have an adverse effect on beneficial uses within the reach of the Truckee River from Lake Tahoe to the California/Nevada State line.

ii. Little Truckee River: Stampede Dam to Boca Reservoir

Sediment transport capacity change exceeds the threshold of significance under TROA, compared to current conditions. However, because this reach is downstream from Stampede Reservoir, the banks are probably armored, and no significant sediment transport or erosion is expected.

Annual sediment transport capacity change is 7 to 10 percent greater under TROA than under No Action in very wet hydrologic conditions and 20 to 33 percent less in median hydrologic conditions. Monthly sediment transport capacity change in median conditions is less from November through July under TROA than under No Action and greater during the remaining months. Therefore, under TROA, slightly more erosion and sediment transport would be likely in this reach in very wet hydrologic conditions and much less would be likely in median hydrologic conditions than under No Action.

Annual sediment transport capacity change is 8 to 11 percent greater under TROA than under current conditions in very wet hydrologic conditions and 15 to 24 percent less in median hydrologic conditions. Monthly sediment transport capacity change in median conditions is less in January, March, and from July through September under TROA than under current conditions. Sediment transport capacity change is greater in the remaining months. Annual sediment capacity change is only 11 percent greater under TROA than under current conditions in very wet hydrologic conditions, and annual sediment transport capacity change is much less in median hydrologic conditions; therefore, erosion and sediment transport in this reach under TROA would be about the same as under current conditions. This reach is downstream from Stampede Reservoir, and as such, is probably armored, and no significant sediment transport or erosion is expected.

iii. Spice

Annual sediment transport capacity change is 8 to 13 percent greater under TROA than under No Action in very wet hydrologic conditions and 9 to 21 percent greater in median hydrologic conditions. Monthly sediment transport capacity change in median hydrologic conditions is less from October through February and in September under TROA than under

No Action. These results suggest significantly more sediment transport and erosion could occur in this reach under TROA than under No Action, but because sediment transport capacity is almost the same or less under TROA than under current conditions (discussed below), no significant sediment transport or erosion is expected in this reach.

Annual sediment transport capacity change is 1 to 2 percent greater under TROA than under current conditions in very wet hydrologic conditions and 9 to 11 percent less in median hydrologic conditions. Monthly sediment transport capacity change in median hydrologic conditions is less from November through April and in July and August under TROA than under current conditions. Thus, less erosion and sediment transport likely would occur in this reach under TROA than under current conditions in this reach.

iv. Lockwood

Annual sediment transport capacity change is 7 to 11 percent greater under TROA than under No Action in wet hydrologic conditions and 7 to 17 percent greater in median hydrologic conditions. Thus, more sediment transport could occur in this reach under TROA than under No Action, but because sediment transport capacity is almost the same or less under TROA than under current conditions (discussed below), no significant sediment transport or erosion is expected in this reach.

Annual sediment transport capacity change is 3 to 5 percent greater under TROA than under current conditions in very wet hydrologic conditions and 2 to 5 percent less in median hydrologic conditions. Monthly sediment transport capacity change in median conditions is less from November through February and from July through September under TROA than under current conditions. The results suggest almost the same sediment transport and erosion in this reach under TROA as under current conditions.

v. Nixon

Annual sediment transport capacity change is 7 to 11 percent greater under TROA than under No Action in wet hydrologic conditions and 2 to 9 percent greater in median hydrologic conditions. Monthly sediment transport capacity change is greater under TROA than No Action from March through June and less the rest of the year. Annual sediment transport capacity change is greater, but not more than 10 percent, under TROA than under No Action (or current conditions, as discussed below). Therefore, slightly more erosion and sedimentation likely would occur in this reach under TROA than under No Action.

Annual sediment transport capacity change is 3 to 5 percent greater under TROA than under current conditions in very wet hydrologic conditions and 2 to 5 percent less in median hydrologic conditions. Monthly sediment transport capacity change is greater under TROA than under current conditions from March through June and less the remainder of the year. These results suggest that almost the same erosion and sediment transport likely would occur in this reach under TROA and current conditions.

5. Mitigation

On Little Truckee River from Stampede Dam to Boca Reservoir, sediment transport capacity change exceeds the threshold of significance under No Action, LWSA, and TROA, compared to current conditions. However, because this reach is downstream from Stampede Reservoir, the banks are probably armored and no significant erosion or sediment transport is expected.

In the Spice and Lockwood reaches of the Truckee River, sediment transport capacity change is greater under TROA than under No Action. However, the sediment transport capacity change is small compared to current conditions and does not exceed the threshold for significance in very wet hydrologic and median hydrologic conditions. Therefore, erosion would not be greater, but sediment deposition could be slightly greater. No mitigation would be required for these reaches.

E. Truckee River Delta Formation at Pyramid Lake

For this indicator, change in water surface elevation and inflow to Pyramid Lake were analyzed to determine the potential for Truckee River delta formation.

Elevations in very wet, median, and very dry (5-, 50-, and 95-percent exceedences) hydrologic conditions, as generated by the operations model, were analyzed because they represent the range of conditions in which the delta and Pyramid Lake could be affected by erosion and sediment transport. The effect on Truckee River delta formation was considered significant if the elevation of Pyramid Lake was 0.5 foot or more lower under the alternatives than under current conditions or under the action alternatives than under No Action.

As shown in table 3.24, there is no or very little change in the water surface elevation (less than 0.2 foot) of Pyramid Lake in very wet, median and very dry conditions under all of the alternatives when compared to either current conditions or No Action. Therefore, the potential for delta expansion would be no greater than under current conditions or No Action.

Sediment transport capacity change, as measured by inflow to Pyramid Lake, also shows no effect on delta formation. The change in annual sediment transport capacity under the all of the alternatives does not exceed threshold of significance (change of 10 percent or more) when compared to either current conditions or No Action. Therefore, the potential for erosion for this reach is the same as under current conditions (table 3.23, Nixon reach).

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

Table 3.24—Water elevation differences at Pyramid Lake in very wet, median, and very dry hydrologic conditions

	Current conditions			No Action			LWSA			TROA		
Month	Very wet	Median	Very dry	Very wet	Median	Very dry	Very wet	Median	Very dry	Very wet	Median	Very dry
Oct	0.00	-0.16	-0.38	0	-0.16	-0.39	0.08	-0.165	-0.39	0	-0.2	-0.37
Nov	0.09	-0.15	-.371	0.151	-0.15	-0.335	0.17	-0.15	-0.331	0.087	-0.16	-0.361
Dec	0.41	-0.08	-.312	0.399	-0.08	-0.321	0.6355	-0.08	-0.311	0.495	-0.12	-0.32
Jan	0.77	0.08	-0.16	0.741	0.08	-0.175	1.045	0.075	-0.175	0.783	0	-0.17
Feb	0.87	0.16	-0.087	0.801	0.16	-0.15	0.9615	0.16	-0.087	0.853	0.15	-0.15
Mar	0.90	0.24	-0.08	0.832	0.225	-0.087	1.1825	0.22	-0.08	0.93	0.195	-0.087
Apr	1.03	0.23	-0.08	0.945	0.195	-0.08	1.3125	0.17	-0.08	1.006	0.23	-0.08
May	1.35	0.38	-0.071	1.347	0.38	-0.07	1.9795	0.39	-0.07	1.361	0.39	-0.07
Jun	0.62	0.08	-0.232	0.566	0.08	-0.221	0.8925	0.08	-0.221	0.641	0.08	-0.221
Jul	0.00	-0.31	-0.514	-0.072	-0.31	-0.522	0.247	-0.31	-0.524	0	-0.305	-0.514
Aug	-0.29	-0.43	-0.58	-0.304	-0.4	-0.56	-0.2175	-0.41	-0.56	-0.259	-0.4	-0.55
Sept	-0.24	-0.39	-.551	-0.23	-0.38	-0.513	-0.16	-0.38	-0.52	-0.54	-0.38	-0.541

BIOLOGICAL RESOURCES

Modifying operations of Truckee River reservoirs could affect the quality, quantity, timing, and duration of flow and the water in lakes and reservoirs. Such changes could potentially affect the habitat and life cycles of aquatic life associated with rivers and tributaries, lake and reservoirs, streamside and wetland habitats and their associated wildlife, and endangered, threatened, and other special status species.

Flow is the most important aspect of a river system because it influences both the physical structure of the substrate (the base on which an aquatic organism lives) and water quality. These two factors help determine the types of plant and invertebrate life present. Other factors that affect aquatic life include stream gradient; water depth; water temperature; water chemistry (e.g., dissolved oxygen; organic and inorganic nutrients, and salinity); substrate type; cover; seasonal variability; aquatic plant and invertebrate abundance; and the presence of other species that are food sources, competitors, or predators. All of these factors interact, and species respond differently to any given set of environmental conditions at different stages of their life cycles.

If other factors influencing temperature are relatively stable, high flow generally results in colder, well-oxygenated water which supports organisms that prefer coldwater conditions. Seasonal excessively high flows, associated with high storm runoff, may scour the river channel, altering the substrate for invertebrates and spawning fish, and removing vegetation. With very low flows, habitat area is reduced, water temperature may increase beyond the tolerance of many species, DO concentrations may decline, and organisms may become stranded in isolated pools. Stranding may result in death or increased stress resulting in lower productivity from oxygen depletion, high water temperature, or increased predation by birds and other predators that can easily reach the trapped invertebrates or fish. However, indigenous species evolved with and adapted to the highly variable flows of the unregulated river system.

Reservoir operations directly affect biological resources associated with upstream lakes and reservoirs (Lake Tahoe, Independence and Donner Lakes, and Prosser Creek, Stampede and Boca Reservoirs) through changes in storage. The release of water from upstream lakes and reservoirs also indirectly affects the amount of water that arrives at Pyramid Lake and Lahontan Reservoir.

The following sections assess the effects of the alternatives on fish in the Truckee River and its affected tributaries; on fish of lakes and reservoirs; on riparian (streamside and wetland) habitat and riparian-associated wildlife; and on endangered, threatened, and other special status species.

FISH IN TRUCKEE RIVER AND AFFECTED TRIBUTARIES

I. AFFECTED ENVIRONMENT

Both native and non-native fish species are found in the Truckee River and its tributaries. Common native fish of the Truckee River include Paiute sculpin, Lahontan redside shiner, Tahoe sucker, speckled dace, and mountain sucker. Recent information shows that mountain whitefish is also common; however, population levels can vary dramatically over time depending on river conditions (Hiscox, 2003; Tisdale, 2003).

Rainbow and brown trout are the most common non-native fish species in the Truckee River from Lake Tahoe to Vista and in many upstream tributaries; carp and mosquitofish are common in the Truckee River downstream from Vista. Additional information on the relative abundance of native and non-native fish in the Truckee River and its upstream tributaries is presented in tables 3.25 and 3.26. The Truckee River from the confluence with Trout Creek to the confluence with Gray Creek has been designated a Wild Trout Water by the California Fish and Game Commission.

Fish species native to the Truckee River are adapted to the highly variable flows of the unregulated river system. Since construction of dams and reservoirs and channelization of portions of the Truckee River, fish have had to cope with regulated flow patterns that differ from natural flows. These changes and the secondary effects they have caused (for example, higher water temperatures), along with the lowering of the elevation of Pyramid Lake, have contributed to the reduction in populations of many native fish.

Beginning in the late 1800s, many non-native fish species were introduced into the Truckee River basin (Truckee River Basin Recovery Implementation Team [TRIT], 2003; Sigler and Sigler, 1987). Rainbow and brown trout have been the two most successful species; natural recruitment is supplemented with annual plantings of hatchery-reared individuals in certain areas to improve recreational fishing (NDOW, 1992b; Wickwire, 1995). Introduced trout are reported to adversely affect the distribution and abundance of native aquatic species in the Sierra Nevada (Moyle, 2002; Knapp, 1994). In an attempt to reduce these impacts, NDOW plans to experiment with stocking triploid (sterile) rainbow trout, which will reduce hybridization with native Lahontan cutthroat trout.

Under current conditions, spawning, incubation, and rearing habitat for native mountain whitefish and non-native brown and rainbow trout in Donner and Prosser Creeks and the Little Truckee River is relatively degraded and reduced in extent compared to historic conditions (CDFG, 1996b). Donner and Prosser Creeks could potentially provide spawning and fry rearing habitat for trout resident to the Truckee River. In the Truckee River, spawning and fry rearing habitat also is degraded, and many of the complex pool habitats critical to juvenile survival have been lost. Available habitat for spawning, incubation, and rearing of salmonid adults is especially restricted during severe drought.

Table 3.25—Abundance of native and non-native fish species in the mainstem Truckee River[1,2]

Species	Lake Tahoe to State line	State line to Vista	Vista to Derby Diversion Dam	Derby Diversion Dam to Marble Bluff Dam
Native fish				
Lahontan cutthroat trout	U-P	U-P	U-P	U-P
Mountain whitefish	C[3]	C	U	U
Paiute sculpin	C	C		
Lahontan redside shiner	C	C	C	C
Speckled dace	C	C	C	C
Lahontan tui chub				U
Tahoe sucker	C	C	C	C
Mountain sucker	U	C	C	C
Cui-ui				U-S
Non-native fish				
Rainbow trout	C	C-R[4]	C	C
Brown trout	C	C-R	C-R	C-R
Brook trout	U	U		
Kokanee salmon	U			U
Goldfish			U	
Carp		U	C	C
Golden shiner			U	
Largemouth bass		U	U	U
Smallmouth bass	U	U	U	U
Green sunfish		U	U	U
Black crappie		U	U	U
Mosquitofish			C	C
Channel catfish			U	U
Brown bullhead		U	U	U
Fathead minnow		U	C	C

[1] Sources: Hiscox, 2003; Molini, 1998; Scoppettone and Bailey, 1983; Tisdale, 2003.
[2] Occurrence classification:
P = Planted (non-reproducing)
R = Planted for recreational fishing
S = Spawning only
C = Common
U = Uncommon
[3] Based on the most recent survey information; however, population levels appear to have wide variation and may be considered uncommon during other periods.
[4] NDOW plans to begin stocking triploid (sterile) fish in 2004.

Table 3.26.—Abundance of native and non-native fish species in the tributaries to the upper Truckee River[1,2]

Species	Donner Creek	Prosser Creek	Independence Creek	Upper Little Truckee River	Lower Little Truckee River
Native fish					
LCT			U-S		U
Mountain whitefish				U	
Paiute sculpin	C			C	C
Lahontan redside shiner		C		C	C
Speckled dace		C		C	C
Tahoe sucker		C		C	U
Mountain sucker		U		U	U
Non-native fish					
Rainbow trout	C	C		C	U-P
Brown trout	C	C		C	C
Brook trout	C	U	C	U	U
Kokanee salmon				C-S[3]	U

[1] Sources: Hiscox, 2003; Scoppettone, 2003
[2] P = Planted (non-reproducing); S = Spawning only; C = Common; U = Uncommon.
[3] Restricted to the lower portion (1 mile), immediately upstream of Stampede Reservoir.

Water temperature and spawning requirements for selected fish species are summarized in table 3.27. Tributaries to the Truckee River in California are important spawning areas for salmonids and other fishes; therefore, effects on these tributaries during spawning periods may affect future fish populations throughout the system.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

CDFG and NDOW recommended flows for reaches (map 3.1) within each agency's jurisdiction, except reach 14 , where habitat/flow relations for the representative fish species are not available (table 3.28; CDFG, 1996b; Warren, 1994; FWS, 1993). Flow recommendations for brown and rainbow trout were derived using the Instream Flow Incremental Methodology (IFIM). Brown and rainbow trout were selected to represent spring and fall/winter spawning salmonids in the Truckee River and because their spawning, incubation, and rearing stages are sensitive to changes in flow. Moreover, data on life stage requirements, required to analyze the effects of flow are not available for most other species. The relation between flow and fish habitat was developed using the Physical Habitat Simulation System (PHABSIM), a set of software and methods that allows computation of relations between flow and physical habitat for various life stages of fish (Bovee and Milhous 1978; Bovee 1982; Stalnaker et al. 1995).

Table 3.27.—Spawning requirements of selected fish species in the Truckee River basin

Species	Habitat	Spawning location	Spawning season/ temperature requirements	Spawning habitat	Fry habitat
Native fish					
Lahontan cutthroat trout	Cold/cool water	Streams	Spring-summer: April-July, 46-61 °F	Gravel riffles	Edge habitat in association with shallow water, low flows, and abundant food
Mountain whitefish	Cold, clear water	Lakes, streams	Fall: October-November, 34-52 °F	Riffles (streams); wave-washed shallows (lakes)	Deep area of lakes, shallow backwaters of streams
Paiute sculpin	Coldwater bottom dweller	Lakes, streams	Spring-summer: May-August, 39-45 °F	Wave-swept littoral areas or stream mouths (lakes); loose gravel/rubble (streams)	Gravels and rocks
Lahontan redside shiner	Variable shallow areas	Lakes, streams	Spring-summer: May-August, 55-75 °F	Sand/gravel shallows	Quiet shallows with cover in lakes/streams
Speckled dace	Variable shallow areas	Lakes, streams	Spring-summer: June-July, 46 °F+	Shallow gravels (lakes); gravel edges of riffles (streams)	Quiet shallows or swampy coves of lakes; channels between large rocks and macrophytes of streams
Lahontan tui chub	Variable	Lakes, streams	Spring-summer: April-July, 43-55 °F	Over macrophyte beds or algae covered rocks and gravel; sandy bottoms and stream mouths (Lake Tahoe)	Shallow weedy areas with cover
Tahoe sucker	Variable	Lakes, streams	Spring-summer: Mar-August, 52-73 °F	Rocks/gravel riffles or gravel bottom lakes	Flooded vegetation resulting from sustained high flows
Mountain sucker	Variable	Streams	Summer: June-August, 52-66 °F	Gravel riffles upstream of pools	Edge habitat and pool macrophyte beds
Cui-ui	Only in Pyramid Lake	Lower Truckee River	Spring: March-June, 57-63 °F	Gravel	Littoral area of Pyramid Lake

Preferred flows were selected for each reach of the Truckee River and its tributaries based on the flow needs of brown and rainbow trout. Maximum and minimum flows were determined by the limits of the flow range that can sustain existing levels of fish populations. Table 3.28 presents maximum, preferred, and minimum flows. Only reaches 1 through 14 were analyzed (map 3.1); the Nixon reach was not assessed because its water temperatures are too high to support reproducing brown and rainbow trout.

Different flows are recommended for different seasons because each fish life stage has different requirements. In general, maximum flows are twice that of optimum or preferred flows. Increases and decreases in flows require ramping rates designed to avoid flushing fish downstream or stranding fish on high ground. When flows are greater than maximum, ramping can occur at any rate without causing additional damage. Preferred flows provide optimum habitat for a specific life stage of the fish species. Minimum flows are the lowest seasonal flows under which the representative fish populations could be maintained. CDFG states, “Due to the substantial reduction in habitat availability at minimum flows (to 50 percent of optimum), it is imperative that flow management providing other than optimum (preferred) flow conditions be accompanied by a spawning and rearing habitat improvement program.”

CDFG had two primary objectives in developing its recommendations: (1) maintain self-sustaining brown and rainbow trout populations and (2) provide recruitment to other tributary trout populations (CDFG, 1996). CDFG defined the minimum flow threshold as follows: (1) for the Truckee River from Lake Tahoe to the State line and the Little Truckee River downstream from Stampede Reservoir, minimum flows were based, primarily, on juvenile rainbow trout habitat availability and, secondarily, on maintaining at least 50 percent of optimum conditions for other life stages; (2) for Donner, Prosser, and Independence Creeks, and for the Little Truckee River upstream of Stampede Reservoir, minimum flows were based on conditions that would not reduce any life stage (except adult rearing habitat availability) below 50 percent of optimum during any period. CDFG determined that a fish population would decline over time if habitat conditions were maintained below 50 percent of optimum, based on using PHABSIM.

NDOW also based its recommendations on data gathered using IFIM, as well as water temperature information for the Truckee River from the California-Nevada State line to Derby Diversion Dam (FWS, 1993). In reaches downstream from Sparks, NDOW assumed (based on field observations) that when summer flow drops below the recommended minimum, all fish will be lost in that reach, primarily due to elevated water temperature (Warren, 1994). The Biological Resources Appendix describes in detail how CDFG and NDOW developed their recommended flows.

New flow recommendations developed by FWS were implemented in 2003 (TRIT, 2003). The purpose of these new flow recommendations, known as the six-flow regime, is to guide the management of Fish Water and, under TROA, Fish Credit Water releases in order to meet ecosystem requirements along the Truckee River. The flow targets under the six-flow regime are based on recommendations for the lower Truckee River (table 3.29), but when water is released to achieve these targets, it is in addition to flows released to meet other flow

Table 3.28.—Flows (in cfs) recommended as maximum[1], preferred, and minimum by CDFG[2] and NDOW in their respective States

River reach/tributary	Brown trout						Rainbow trout					
	October-January			February-March			April-July			August-September		
	Spawning and incubation			Rearing			Spawning and incubation			Rearing		
	Max.	Pref.	Min.	Max.	Pref.	Min.	Max.	Pref.	Min.	Max.	Pref.	Min.
Little Truckee River, downstream from Stampede Reservoir	250	125	45	200	100	45	250	125	45	200	100	45
Little Truckee River, upstream from Stampede[3] Reservoir		90			50			90			30	
Donner Creek[4]	100	50	8				100	50	[6]8	20	10	[6]8
Prosser Creek[5]	100	50	25	70	35	25	150	75	12	60	30	25
Independence Creek	40	20	7	20	10	4	40	20	8	20	10	4
Truckee River from Lake Tahoe to Donner Creek[6]	600	300	75	500	250	75	600	300	75	500	250	75
Donner Creek to Little Truckee River	600	300	100	500	250	100	600	300	100	500	250	100
Truckee River from Little Truckee River to Trophy	600	300	150	500	250	150	600	300	150	500	250	150
Mayberry		200	100		200	100		300	200		300	200
Oxbow		200	100		200	100		300	200		300	200
Spice		200	100		200	100		250	150		250	150
Lockwood		350	250		350	250		350	250		350	250

[1] Maximum flow recommendations are only provided for the Truckee River in California.

[2] CDFG recommendations for reaches in California are for support of self-sustaining brown and rainbow trout fisheries.

[3] While minimum flows are specified in the IFIM report (CDFG, 1996), no controlled-release facility exists for this reach.

[4] California Dam Safety Requirements require that the gates at Donner Lake remain open from November 15 to April 15; minimum flow recommendations apply only from April 5 to November 15.

[5] Since physical constraints prevent releases between 12 cfs and 25 cfs, this is the minimum flow until the dam is modified to allow a minimum flow of 16 cfs throughout the year, which is recommended by the IFIM report (CDFG, 1996).

[6] Reduced to 5 cfs or natural inflow, whichever is less, when lake is projected to have less than 8,000 acre-feet of storage on Labor Day.

[7] Due to changes in the condition of the river channel since the IFIM studies were conducted, preferred flows in these reaches have been increased from the recommendations specified in the IFIM report (CDFG, 1996).

Table 3.29.—The ecosystem-based six-flow regime recommendations for the lower Truckee River (TRIT, 2003)

Month	Regime (cfs)					
	1	2	3	4	5	6
January	160	150	120	110	100	90
February	160	150	120	110	100	90
March	290	220	200	160	160	140
April	590	490	420	350	300	200
May	1000	800	600	530	400	300
June	800	600	500	400	270	170
July	300	300	300	200	150	120
August	200	200	200	200	150	110
September	170	170	120	110	100	100
October	160	150	120	110	100	100
November	160	150	120	110	100	90
December	160	150	120	110	100	90
Total (acre-feet)	249,000	211,800	176,400	150,000	121,800	96,000

requirements; therefore it does not replace, but augments, flow already in the river. The six-flow regime emphasizes maintaining essential flows while attempting to mimic the river's natural hydrologic variability, given water availability in any particular year. While the six-flow regime considers the biological requirements of fish, it also incorporates ecosystem considerations, such as flows that enhance the establishment and maintenance of willow and cottonwoods. Regimes 1, 2, and 3 are intended to promote cui-ui spawning in above-average, average, and below-average water years, respectively. In above-average and wetter years, the focus of the six-flow regime is on the gradual ramping down of spring and summer flows to facilitate willow and cottonwood recruitment. Regimes 4, 5, and 6 are recommended during dry, very dry, and extremely dry years, respectively. Under regimes 3 though 6, the management focus is on using available runoff to maintain year-around flows to benefit the ecosystem. For example, enhanced riparian growth and maintenance resulting from higher summer and fall flows increases shading. In turn, increased shading lowers water temperatures. More detail on the six-flow regime and the process used to determine them is included in the discussion of cui-ui in "Endangered, Threatened, and Other Special Status Species" and in the Biological Resources Appendix.

Changes in flow within the Truckee River basin could significantly affect the amount of habitat available for various life stages of fish associated with rivers and tributaries. In addition, low flow in the Truckee River reach from Hunter Creek to East McCarran Boulevard could result in formation of anchor ice in winter and predation or death from high temperature or anoxia in summer.

To evaluate the potential effects on the non-native trout fishery in the Truckee River and its tributaries, the following indicators were chosen; the results of each analysis are described in this section. (Potential effects of diversions from the Truckee River to Sierra Pacific's four hydroelectric plants are not considered in the following indicators, but addressed separately at this end of this chapter.)

1. Frequency that preferred flows for various life stages of brown trout from October through March (fall/winter months) are achieved or exceeded without exceeding maximum flows.

2. Frequency that minimum flows for various life stages of brown trout from October through March (fall/winter months) are sustained.

3. Frequency that preferred flows for various life stages of rainbow trout from April through September (spring/summer) are achieved or exceeded without exceeding maximum flows.

4. Frequency that minimum flows for various life stages of rainbow trout from April through September (spring/summer) are sustained.

5. Frequency of flushing/stranding flows.

6. Frequency of low flows in winter months that increase the potential for anchor ice formation.

B. Frequency that Preferred Flows for Various Life Stages of Brown Trout from October through March Are Achieved or Exceeded Without Exceeding Maximum Flows

1. Summary of Effects

Analysis of operations model results for the frequency that preferred flows for brown trout are achieved or exceeded without exceeding maximum flows shows that under TROA, significant beneficial effects would occur in Donner Creek, where only the month of October was analyzed. No effects would occur under either No Action or LWSA. Table 3.30 summarizes these effects.

2. Method of Analysis

The frequency that preferred flows for brown trout are achieved or exceeded without exceeding maximum flows from October through March (as generated by the operations model) was analyzed. Average monthly flows for each month from October through March were tallied if they were equal to or greater than the preferred flow and equal to or less than the maximum flow (when specified) for brown trout spawning, incubation, and rearing.

3. Threshold of Significance

Each stretch of river, or reach, can have different channel morphology and habitat conditions that can influence the effects of changes in flows on fish populations. Preferred flows provide the greatest amount of optimum habitat for brown and rainbow trout; however, trout

Table 3.30.—Summary of effects: frequency that preferred flows for brown trout are achieved or exceeded without exceeding maximum flows (when specified)
(+ = significant beneficial effect, - = significant adverse effect)

	Compared to current conditions			Compared to No Action	
River reach/tributary	No Action	LWSA	TROA	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	No effect				
Truckee River from Donner Creek to Little Truckee River					
Truckee River from Little Truckee River to Trophy					
Trophy					
Mayberry					
Oxbow					
Spice					
Lockwood					
Donner Creek (October only)	No effect		+	No effect	+
Prosser Creek	No effect				
Independence Creek					
Little Truckee River upstream from Stampede Reservoir					
Little Truckee River downstream from Stampede Reservoir					

can reproduce at lower flows. Changes in trout populations due to changes in flows are dependent on several factors that must be taken into account for each situation. These include the following: (1) The frequency of achieving or sustaining preferred flows, both in relative differences and absolute values; (2) the possibility of recruitment of fish from other reaches (fish movement into a reach from other reaches and on-stream reservoirs); and (3) the possibility of lethal flows (i.e., a flow below the minimum or above the maximum). Thus, best professional judgment was required to weigh these differences in specific reaches and determine the significance of effects.

Examples of the relative and absolute differences in significance of changes in flows can be understood in the following examples. A 5-percent (absolute) difference in the frequency of flows may not be likely to have a significant effect on the trout population if the relative frequencies of achieving a flow are already high, such as the difference between 75 and 80 percent. However, when the frequencies are low, such as 25 percent or lower, a 5-percent (absolute) difference will actually result in relative flow change of 20 percent or greater. When absolute frequency values are in the range of 30 to 70 percent, differences of only a few percentage points are unlikely to have a significant effect on trout species.

Large absolute differences in achieving preferred or sustained flows (15 percent or greater) are more likely to produce a significant effect in trout populations than lesser relative differences in flow (8 to 15 percent). Assigning a determination of significance at these lesser levels is more challenging. In such cases, the relative frequency of flows outside of the preferred range (lethal flows in particular) was considered within the analysis. Because lethal flows directly influence trout survival, a difference in their frequency in combination with a moderate difference in the frequency of flows that support spawning, incubation, and rearing, was considered to increase the potential for a measurable adverse effect. The underlying assumption is that while a moderate change in achieving or sustaining preferred flows may have a short-term effect on trout reproductive success, the magnitude of this effect on the overall trout population over the long-term would be offset to some degree if temperatures lethal to the fish population occur less frequently. However, an increase in the frequency of lethal temperatures was considered to increase the potential for adverse effects on spawning, incubation, and rearing in trout.

4. Model Results

Table 3.31 presents operations model results for the frequency (percent of months) that preferred flows for various life stages of brown trout from October through March (fall/winter months) are achieved or exceeded without exceeding maximum flows (when specified) in the Truckee River and its tributaries.

5. Evaluation of Effects

a. No Action

Operations model results show that preferred flows for brown trout are achieved about as frequently under No Action as under current conditions in all reaches of the Truckee River and its tributaries. There would be no effect.

b. LWSA

Preferred flows for brown trout are achieved as frequently or about as frequently under LWSA as under No Action and current conditions in all reaches of the Truckee River and its tributaries. There would be no effect.

c. TROA

Operations model results show that in most reaches of the Truckee River and its upper tributaries, preferred flows for brown trout are achieved about as frequently under TROA as under current conditions (differences of only a few percent). Such small differences do not constitute a significant effect. These reaches are not discussed further. Reaches with no effect also are not discussed.

In Donner Creek, preferred flows for brown trout are achieved 3 times more frequently under TROA than under current conditions. (Only the month of October was analyzed for Donner Creek because California Dam Safety Requirements preclude storing water in Donner Lake

Table 3.31.—Frequency (percent of months) that preferred flows for brown trout from October through March are achieved or exceeded without exceeding maximum flows (when specified)

River reach/tributary	Current conditions	No Action	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	10	11	11	6
Truckee River from Donner Creek to Little Truckee River	25	26	26	17
Truckee River from Little Truckee Riverto Trophy	58	58	57	45
Trophy	93	93	92	93
Mayberry	93	92	92	88
Oxbow	93	90	90	82
Spice	92	89	89	79
Lockwood	87	86	86	79
Donner Creek (October only)[1]	14	14	14	47
Prosser Creek	22	22	22	23
Independence Creek	18	18	18	18
Little Truckee River upstream from Stampede Reservoir	26	26	26	25
Little Truckee River downstream from Stampede Reservoir	22	22	22	22

[1]California Dam Safety Requirements require that the gates at Donner Lake dam remain open from November 15 to April 15. October is the only full spawning month in which Donner Lake releases can be controlled.

from November 15 to April 15, which precludes the possibility of controlled releases.) As a result, brown trout spawning in Donner Creek should be enhanced, which would be significant beneficial effect under TROA.

In the two upper reaches of the Truckee River, operations model results show that preferred flows for brown trout are achieved slightly more than half of as frequently under TROA as under No Action or current conditions. Because preferred flows are achieved only 11 and 10 percent of the time under No Action and current conditions, respectively, the potential effects under TROA were examined on a monthly basis. Results show that potential adverse effects occur only in October when, based on Truckee River flow at Donner Creek, preferred flows for brown trout are achieved only 13 percent of the time under TROA, compared to 38 percent of the time under No Action, and 34 percent of the time under current conditions. CDFG states that if flows are not adequate for spawning in October, fish may hold in deep pools and spawn later when flow is higher (Hiscox, 2004). Therefore, while lower flows may be adverse for spawning, incubation, and rearing of brown trout in one month in one reach, the lower flow under TROA does not constitute a significant adverse effect overall.

In a few reaches, the frequencies that preferred flows for brown trout are achieved differ by 8 to 13 percent. To better assess the significance of these differences, the frequency that lethal flows occur in these reaches also was evaluated. These reaches are discussed individually, as follows.

Truckee River from Little Truckee River to Trophy: In this reach, preferred flows for brown trout are achieved in 58 percent of the fall/winter months under current conditions compared to 45 percent under TROA, a difference of 13 percent.

Lethal flows occur in 36 percent of the fall/winter months under current conditions, compared to 35 percent under TROA. Because this small difference in the frequency of lethal flows is not likely to have a significant effect on adult survival and recruitment from other reaches of the river is likely to occur, the moderate difference in the frequency of achieving preferred flows for brown trout in this reach is not considered a significant effect on the long-term survival of the brown trout population.

Oxbow: In the Oxbow reach, preferred flows for brown trout are achieved in 82 percent of the fall/winter months under TROA compared to 93 percent under current conditions. This 11-percent difference is a potential adverse effect. Lethal flows occur in 5 percent of the fall/winter months under TROA, compared to 3 percent under current conditions. Because this small difference in the frequency of lethal flows is not likely to have a significant effect on adult survival and recruitment from other reaches of the river, the moderate difference in the frequency of achieving preferred flows for brown trout in this reach is not considered a significant effect on the long-term survival of the brown trout population.

Spice: In the Spice reach, preferred flows for brown trout are achieved in 79 percent of the fall/winter months under TROA compared to 92 percent under current conditions. This 13-percent difference is a potential adverse effect. Lethal flows occur in 6 percent of the fall/winter months under TROA compared to 4 percent under current conditions. Because this small difference in the frequency of lethal flows is not likely to have a significant effect on adult survival and recruitment from other reaches of the river, the moderate difference in the frequency of achieving preferred flows for brown trout in this reach is not considered a significant effect on the long-term survival of the brown trout population.

Lockwood: In the Lockwood reach, preferred flows for brown trout are achieved in 79 of the fall/winter months under TROA compared to 87 percent under current conditions. This 8-percent difference is a potential adverse effect. Lethal flows occur in 8 percent of the fall/winter months under TROA compared 6 percent under current conditions. Because this small difference in the frequency of lethal flows is not likely to have a significant effect on adult survival and recruitment from other reaches of the river, the moderate difference in the frequency of achieving preferred flows for brown trout in this reach is not considered a significant effect on the long-term survival of the brown trout population.

Operations model results show that differences between TROA and No Action in the frequencies that preferred flows for brown trout are achieved are similar to the differences between TROA and current conditions. In most reaches of the Truckee River and its upper tributaries within the study area, preferred flows for brown trout are achieved about as frequently under TROA as under No Action (differences of only a few percent). Such small differences do not constitute a significant effect.

The same beneficial effect would occur in October on Donner Creek when TROA is compared to No Action as when it is compared to current conditions.

The differences in the frequency that preferred flows for brown trout are achieved in the Truckee River from Little Truckee River to the Trophy reach and in the Oxbow, and Spice reaches between TROA and No Action are less than the differences between TROA and current conditions, and the difference between TROA and No Action both in the Truckee River between Donner Creek and in the Little Truckee River is only 1 percent. TROA would, therefore, have no significant adverse effects in these reaches when compared to No Action.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur to brown trout in the Truckee River or its tributaries under any of the alternatives.

C. Frequency that Minimum Flows for Various Life Stages of Brown Trout from October through March Are Sustained

1. Summary of Effects

Analysis of operations model results for the frequency that minimum flows for brown trout during the fall/winter months are sustained shows that, under TROA, a significant beneficial effect would occur in five reaches of the Truckee River and its tributaries (table 3.32). Significant adverse effects would occur in the Truckee River from the confluence of the Little Truckee River to Trophy under No Action and LWSA, when compared to current conditions.

2. Method of Analysis

The frequency that minimum flows for spawning, incubating, and rearing brown trout from October through March are sustained (as generated by the operations model) was analyzed. Qualifying years were those in which flow was between the specified minimum and maximum for the entire 6-month period.

3. Threshold of Significance

The same threshold of significance was used as for the first indicator of fish in the Truckee River and its tributaries.

4. Model Results

Table 3.33 presents operations model results for the frequency (percent of years) that minimum flows for various life stages of brown trout from October through March (fall/winter months) are sustained in the Truckee River and its tributaries.

Table 3.32.—Summary of effects: frequency that minimum flows for brown trout are sustained
(+ = significant beneficial effect, - = significant adverse effect)

	Compared to current conditions			Compared to No Action	
River reach/tributary	No Action	LWSA	TROA	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	No effect		+	No effect	
Truckee River from Donner Creek to Little Truckee River	No effect				
Truckee River from Little Truckee River to Trophy	-	-	No effect		+
Trophy	No effect				
Mayberry					
Oxbow					
Spice					
Lockwood					
Donner Creek (October only)[1]	No effect		+	No effect	+
Prosser Creek	No effect				
Independence Creek	No effect		+	No effect	+
Little Truckee River upstream from Stampede Reservoir[2]	Not applicable				
Little Truckee River downstream from Stampede Reservoir	No effect		+	No effect	+

[1] California Dam Safety Requirements require that the gates at Donner Lake dam remain open from November 15 to April 15. October is the only full spawning month in which Donner releases can be controlled.
[2] No minimum flow is identified because there is no controlled-release facility for this reach.

Table 3.33.—Frequency (percent of years) that minimum flows for brown trout from October through March are sustained

River reach/tributary	Current conditions	No Action	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	15	14	14	22
Truckee River from Donner Creek to Little Truckee River	45	42	42	44
Truckee River from Little Truckee River to Trophy	22	17	16	23
Trophy	93	96	96	100
Mayberry	93	94	94	93
Oxbow	92	91	90	91
Spice	89	86	86	87
Lockwood	86	85	85	81
Donner Creek (October only)[1]	79	85	85	98
Prosser Creek	3	1	1	2
Independence Creek	3	3	3	32
Little Truckee River upstream from Stampede Reservoir[2]	Not applicable			
Little Truckee River downstream from Stampede Reservoir	9	6	6	26

[1] California Dam Safety Requirements require that the gates at Donner Lake dam remain open from November 15 to April 15. October is the only full spawning month in which Donner releases can be controlled.
[2] No minimum flow is identified because there is no controlled-release facility for this reach.

5. Evaluation of Effects

a. No Action

Minimum flows for brown trout are sustained less frequently in the fall/winter months under No Action than under current conditions in the reach of the Truckee River from Little Truckee River to Trophy. Although difference in frequency is only 5 percent, it would result in a significant adverse effect because minimum flows are sustained infrequently in this reach; it represents a more than 20-percent change from current conditions. Reaches with no effect are not discussed.

b. LWSA

In the Truckee River from Little Truckee River to Trophy, minimum flows for brown trout in the fall/winter months are sustained as frequently under LWSA as under No Action and less frequently than under current conditions. Because minimum flows are sustained infrequently, the 6-percent difference actually represents more than a 25-percent change from current conditions, which would be a significant adverse effect. Reaches with no effect are not discussed.

c. TROA

Minimum flows for brown trout are sustained significantly more frequently under TROA than under current conditions in two reaches of the Truckee River and three reaches of its tributaries. Reaches with no effect are not discussed.

Truckee River from Lake Tahoe to Donner Creek: Minimum flows for brown trout are sustained moderately (8 percent) more frequently under TROA than under No Action. Because minimum flows are sustained infrequently, the difference actually represents nearly a 60-percent change from No Action, which would reduce brown trout mortality and would be a significant beneficial effect under TROA.

Minimum flows for brown trout are sustained 7 percent more frequently under TROA than under current conditions. Because minimum flows are sustained infrequently, the difference actually represents nearly a 45-percent change from current conditions, which, again, would be a significant beneficial effect under TROA.

Truckee River from Little Truckee River to Trophy: Minimum flows for brown trout are sustained 5 percent more frequently under TROA than under No Action. Because minimum flows are sustained infrequently, the difference actually represents nearly a 35-percent change from No Action, which would be a significant beneficial effect under TROA.

Minimum flows for brown trout are sustained 1 percent more frequently under TROA than under current conditions, which would not be a significant beneficial effect.

Donner Creek: California Dam Safety Requirements preclude storing water in Donner Lake from November 15 to April 15, which precludes the possibility of controlling releases. Therefore, the minimum flows analysis for Donner Lake releases includes only the month of October. Minimum flows for brown trout are sustained 98 percent of years under TROA compared to 85 percent under No Action, which would be a significant beneficial effect.

Minimum flows for brown trout are sustained 19 percent more frequently under TROA than under current conditions, which would be a significant beneficial effect.

Independence Creek: Minimum flows for brown trout are sustained in 32 percent of years under TROA compared to 3 percent under No Action, which would be a significant beneficial effect. Minimum flows for brown trout are sustained 10 times more frequently under TROA than under current conditions, which would be a significant beneficial effect.

Little Truckee River downstream from Stampede Reservoir: Minimum flows for brown trout are sustained more than 4 times more frequently under TROA than under No Action, which would be a significant beneficial effect. Minimum flows for brown trout are sustained 3 times more frequently under TROA than under current conditions, this also would be a significant beneficial effect under TROA.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. A significant beneficial effect to brown trout spawning, incubation, and rearing in two reaches of the Truckee River and in three of its tributaries would occur under TROA.

D. Frequency that Preferred Flows for Various Life Stages of Rainbow Trout from April through September Are Achieved or Exceeded Without Exceeding Maximum Flows

1. Summary of Effects

Analysis of operations model results for the frequency that preferred flows for rainbow trout are achieved or exceeded without exceeding maximum flows shows that significant beneficial effects would occur under TROA in the Truckee River from Little Truckee River to the Trophy reach, in the Oxbow and Spice reaches, compared to current conditions, and in Donner, Prosser, and Independence Creeks. No significant effects would occur under No Action or LWSA. Table 3.34 summarizes these effects.

2. Method of Analysis

The frequency that preferred flows for rainbow trout are achieved or exceeded from April through September without exceeding maximum flows (as generated by the operations

Table 3.34.—Summary of effects: frequency that preferred flows for rainbow trout are achieved or exceeded without exceeding maximum flows
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">River reach/tributary</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td>Truckee River from Lake Tahoe to Donner Creek</td><td colspan="5" rowspan="2">No effect</td></tr>
<tr><td>Truckee River from Donner Creek to Little Truckee River</td></tr>
<tr><td>Truckee River from Little Truckee River to Trophy</td><td colspan="2">No effect</td><td>+</td><td>No effect</td><td>+</td></tr>
<tr><td>Trophy</td><td colspan="5" rowspan="2">No effect</td></tr>
<tr><td>Mayberry</td></tr>
<tr><td>Oxbow</td><td colspan="2" rowspan="2">No effect</td><td>+</td><td colspan="2" rowspan="2">No effect</td></tr>
<tr><td>Spice</td><td>+</td></tr>
<tr><td>Lockwood</td><td colspan="5">No effect</td></tr>
<tr><td>Donner Creek (October only)</td><td colspan="2" rowspan="3">No effect</td><td>+</td><td rowspan="3">No effect</td><td>+</td></tr>
<tr><td>Prosser Creek</td><td>+</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River upstream from Stampede Reservoir</td><td colspan="5" rowspan="2">No effect</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td></tr>
</table>

model) was analyzed. Average monthly flows from each month from April through September were tallied if they were equal to or greater than the preferred flow and equal to or less than the maximum flow (when specified) for rainbow trout spawning, incubation, and rearing.

3. Threshold of Significance

The same threshold of significance was used as for the first indicator of fish in the Truckee River and its tributaries.

4. Model Results

Table 3.35 presents operations model results for the frequency (percent of months) that preferred flows for various stages of rainbow trout from April through September are achieved or exceeded without exceeding maximum flows (when specified) in the Truckee River and its tributaries.

5. Evaluation of Effects

a. No Action

Preferred flows for rainbow trout are achieved 13 and 12 percent more frequently under No Action than under current conditions in the Oxbow and Spice reaches of the Truckee River,

Table 3.35.—Frequency (percent of months) that preferred flows for rainbow trout from April through September are achieved or exceeded without exceeding maximum flows (when specified)

River reach/tributary	Current conditions	No Action	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	26	26	26	27
Truckee River from Donner Creek to Little Truckee River	28	29	29	27
Truckee River from Little Truckee River to Trophy	21	24	25	41
Trophy	96	96	96	97
Mayberry	95	96	96	97
Oxbow	82	95	95	96
Spice	82	94	94	96
Lockwood	80	75	75	74
Donner Creek (October only)	18	18	18	31
Prosser Creek	25	25	24	34
Independence Creek	29	29	29	37
Little Truckee River upstream of Stampede Reservoir	60	60	60	57
Little Truckee River downstream of Stampede Reservoir	26	25	25	29

respectively. These higher flows should result in more successful spawning, incubation, and rearing of rainbow trout in these reaches and would be a significant beneficial effect under No Action. Many other reaches show identical flows or differences of a few percent. Such differences are too small to produce a predictable biological response and are unlikely to have a significant effect. Other than in the Oxbow and Spice reaches, the greatest difference is 5-percent lower flows in the Lockwood reach. Because preferred flows already are achieved in 80 percent of months, this difference would be unlikely to have a significant adverse effect.

b. LWSA

Preferred flows for rainbow trout are achieved 13 and 12 percent more frequently under LWSA than under current conditions, respectively. These higher flows should result in more successful spawning, incubation, and rearing of rainbow trout in these reaches and are a significant beneficial effect when LWSA is compared to current conditions. Compared to both No Action and current conditions, flows in reaches are identical flows or differ by only a few percent. Such differences are too small to produce a predictable biological response and are unlikely to have a significant effect. Other than in the Oxbow and Spice reaches, the greatest difference is 5-percent lower flows in the Lockwood reach than under current conditions. Because preferred flows already are achieved in 80 percent of months, this difference would be unlikely to have a significant adverse effect.

c. TROA

In the Truckee River from Little Truckee River to Trophy and in Donner, Prosser, and Independence Creeks, preferred flows for rainbow trout are achieved moderately to substantially more frequently under TROA than under No Action. Preferred flows also are achieved moderately more frequently under TROA than under current conditions in the Oxbow and Spices reaches. These differences are discussed by reach. Reaches with no effect are not discussed.

Truckee River from Little Truckee River to Trophy: Preferred flows for rainbow trout are achieved 17 percent more frequently under TROA than under No Action and 20 percent more frequently than under current conditions. Because preferred flows occur infrequently under No Action and current conditions, these differences represent a near doubling of the number of months in which preferred flows are achieved. More successful spawning, incubation, and rearing of rainbow trout should occur in this reach, which would be a significant beneficial effect under TROA.

Oxbow Reach: Preferred flows rainbow trout are achieved 21 percent more frequently under TROA than under No Action and 14 percent more frequently than under current conditions. The latter difference is potentially significant. Lethal flows occur in 2.8 percent of the spring/summer months under TROA compared to 4.5 percent under current conditions. The difference in achieving preferred flows, in combination with the small difference in the occurrence of lethal flows, would be significant beneficial effect under TROA.

Spice Reach: Preferred flows for rainbow trout are achieved 2 percent more frequently under TROA than under No Action. There would be no effect. Preferred flows are achieved 14 percent more frequently under TROA than under current conditions; this substantial difference is potentially significant. Lethal flows occur in 3 percent of the spring/summer months under TROA, compared to 4 percent under current conditions. The difference in achieving preferred flows, in combination with the small difference in the occurrence of lethal flows, would be a significant beneficial effect under TROA.

Donner Creek: Preferred flows for rainbow trout are achieved 13 percent more frequently under TROA than under either No Action or current conditions. This is only a moderate difference, but its actual effect would be greater because preferred flows occur infrequently in this reach under No Action and current conditions. This difference should have a beneficial effect on spawning, incubation, and rearing of rainbow trout in this reach and would be a significant beneficial effect under TROA.

Prosser Creek: Preferred flows for rainbow trout are achieved 9 percent more frequently under TROA than under either No Action or current conditions. This is only a moderate difference, but its actual effect would be greater because preferred flows occur infrequently in this reach under No Action and current conditions. This difference should have a beneficial effect on spawning, incubation, and rearing of rainbow trout in this reach and would be a significant beneficial effect under TROA.

Independence Creek: Preferred flows for rainbow trout are achieved 8 percent more frequently under TROA than under either No Action or current conditions. This is a moderate, but potentially adverse effect. Lethal flows occur in Independence Creek in 63 percent of the spring/summer months under No Action and in 60 percent of months under current conditions compared to 42 percent under TROA, or one-third less frequently. This difference should have a beneficial effect on rainbow trout spawning, incubation, and rearing and would be a significant beneficial effect under TROA.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect to rainbow trout spawning, incubation, and rearing in three reaches of the Truckee River and in three of its tributaries would occur under TROA.

E. Frequency that Minimum Flows for Various Life Stages of Rainbow Trout from April through September Are Sustained

1. Summary of Effects

Analysis of operations model results for the frequency that minimum flows for rainbow trout are sustained shows that a significant beneficial effect would occur under TROA in the Truckee River downstream from Lake Tahoe to Donner Creek, in Prosser and Independence Creeks, and in the Little Truckee River downstream from Stampede Reservoir. No effect would occur under either No Action or LWSA. Table 3.36 summarizes these effects.

Table 3.36.—Summary of effects: frequency that minimum flows for rainbow trout are sustained
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">River reach/tributary</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td>Truckee River from Lake Tahoe to Donner Creek</td><td colspan="2">No effect</td><td>+</td><td>No effect</td><td>+</td></tr>
<tr><td>Truckee River from Donner Creek to Little Truckee River</td><td colspan="5" rowspan="8">No effect</td></tr>
<tr><td>Truckee River from Little Truckee River to Trophy</td></tr>
<tr><td>Trophy</td></tr>
<tr><td>Mayberry</td></tr>
<tr><td>Oxbow</td></tr>
<tr><td>Spice</td></tr>
<tr><td>Lockwood</td></tr>
<tr><td>Donner Creek (October only)</td><td colspan="5">No effect</td></tr>
<tr><td>Prosser Creek</td><td colspan="2" rowspan="2">No effect</td><td>+</td><td rowspan="2">No effect</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River upstream of Stampede Reservoir[1]</td><td colspan="5">Not applicable</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td><td colspan="2">No effect</td><td>+</td><td>No effect</td><td>+</td></tr>
</table>

[1] No minimum flow is identified because there is no controlled release facility for this reach.

2. Method of Analysis

The frequency that minimum flows for spawning, incubating, and rearing rainbow trout from April through September are sustained (as generated by the operations model) was evaluated. Qualifying years were those in which flow was between the specified minimum and maximum for the entire 6-month period.

3. Threshold of Significance

The same threshold of significance was used as for the first indicator of fish in the Truckee River and its tributaries.

4. Model Results

Table 3.37 presents operations model results for the frequency (percent of years) that minimum flows for rainbow trout are sustained from April through September without exceeding maximum flows (when specified) in the Truckee River and its tributaries.

Table 3.37.—Frequency (percent of years) that minimum flows for rainbow trout from April through September are sustained

River reach/tributary	Current conditions	No Action	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	2	2	2	27
Truckee River from Donner Creek to Little Truckee River	14	14	14	12
Truckee River from Little Truckee River to Trophy	1	1	1	1
Trophy	92	92	92	94
Mayberry	91	92	92	93
Oxbow	89	89	89	93
Spice	89	89	89	93
Lockwood	88	88	88	92
Donner Creek (October only)	0	0	0	0
Prosser Creek	1	1	1	11
Independence Creek	0	0	0	7
Little Truckee River upstream of Stampede Reservoir[1]	Not applicable			
Little Truckee River downstream from Stampede Reservoir	1	1	1	14

[1] No minimum flow is identified because there is no controlled release facility for this reach.

5. Evaluation of Effects

a. No Action

Minimum flows for rainbow trout are sustained almost as frequently under No Action as under current conditions (difference of no more than 1 percent). There would be no effect.

b. LWSA

Minimum flows for rainbow trout are sustained almost as frequently under LWSA as under No Action or current conditions (differences of no more than 1 percent). There would be no effects.

c. TROA

Minimum flows for rainbow trout are sustained substantially more frequently under TROA than under either No Action or current conditions in the Lake Tahoe to Donner Creek reach of the Truckee River, in Prosser and Independence Creeks, and in the Little Truckee River downstream from Stampede Reservoir. These results are discussed by reach. Reaches with no effect are not discussed.

Truckee River from Lake Tahoe to Donner Creek: Minimum flows for rainbow trout are sustained substantially more frequently in this reach under TROA than under No Action or current conditions: in 27 percent of years under TROA compared to only 2 percent under No Action and current conditions. This large difference would have a beneficial effect on spawning, incubation, and rearing of rainbow trout and would be a significant beneficial effect under TROA.

Prosser Creek: Minimum flows for rainbow trout in Prosser Creek are sustained substantially more frequently under TROA than under No Action or current conditions: 11 percent of years under TROA compared to only 1 percent under No Action and current conditions. This large difference would have a beneficial effect on spawning, incubation, and rearing of rainbow trout, and would be a significant beneficial effect under TROA.

Independence Creek: Minimum flows for rainbow trout in Independence are sustained substantially more frequently under TROA than under No Action or current conditions. Under both No Action and current conditions minimum flows are never sustained, compared to 14 percent under TROA. This large difference would have a beneficial effect on spawning, incubation, and rearing of rainbow trout and would be a significant beneficial effect under TROA.

Little Truckee River downstream from Stampede Reservoir: Minimum flows for rainbow trout in this reach are sustained substantially more frequently under TROA than under No Action or current conditions. Under both No Action and current conditions, minimum flows are sustained in only 1 percent of years, compared to 14 percent under TROA. This large difference would have a beneficial effect on spawning, incubation, and rearing of rainbow trout and would be a significant beneficial effect under TROA.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect to rainbow trout spawning, incubation, and rearing in three reaches of the Truckee River and in three of its tributaries under TROA.

F. Frequency of Flushing/Stranding Flows

1. Summary of Effects

Analysis of operations model results shows that flows that may strand fish or flush fish downstream in Prosser Creek and in the Little Truckee River downstream from Stampede Reservoir from October through March occur much less frequently under TROA, which would be a significant beneficial effect. Table 3.38 summarizes these effects.

Table 3.38.—Summary of effects: frequency that flushing/stranding flows occur
(+ = significant beneficial effect, - = significant adverse effect)

Tributary	Period	Compared to current conditions			Compared to No Action	
		No Action	LWSA	TROA	LWSA	TROA
Prosser Creek	Oct-Mar	+	+	+	No effect	+
	Apr-Sep	No effect				
Little Truckee River downstream from Stampede Reservoir	Oct-Mar	No effect		+	No effect	+
	Apr-Sep	No effect				

2. Method of Analysis

For this analysis, a flushing/stranding flow is one that is 2 times or more greater than the preferred flow for any given reach. CDFG has identified Prosser Creek and the Little Truckee River downstream from Stampede Reservoir as having the greatest problems with large flushing flows. To determine the frequency of flushing/stranding flows, flows in Prosser Creek and the Little Truckee River downstream from Stampede Reservoir for all months (generated from the operations model) were analyzed.

3. Threshold of Significance

Prosser Creek and the Little Truckee River each has its own brown and rainbow trout habitat conditions and channel morphology that can dramatically influence the effects of changes in the frequency of flushing/stranding flows on fish populations. Quantification of long-term effects of flushing/stranding flows is confounded by recruitment from other adjacent reaches and on-stream reservoirs. An absolute threshold value above or below which an effect is demonstrably significant is not, therefore, biologically defensible.

Interpretations of differences in the frequency of flushing/stranding flows must be based on best professional judgment, taking into consideration not just the relative difference in the frequencies being compared but also the absolute value of those frequencies. Operations model results show that flushing/stranding flows occur in 15 to 53 percent of years. The greatest differences among the alternatives occur in the fall/winter months, when frequency decreases range between 6 and 13 percent of years on Prosser Creek and between 8 and 12 percent on the Little Truckee River downstream from Stampede Reservoir. Although the value ranges are similar on the two reaches, flushing/stranding flows on Prosser Creek occur only about half as frequently as on the Little Truckee River. For this reason, the same relative difference in frequency of flushing/stranding flows cannot be expected to affect the two reaches to the same degree.

4. Model Results

Table 3.39 presents operations model results for the frequency (percent of years) that flushing/stranding flows occur (i.e., average monthly flows are equal to or are greater than twice the preferred flows for the representative fish species for that month).

Table 3.39.—Frequency (percent of years) that flushing/stranding flows (i.e., twice preferred flows or greater) occur

Tributary		Current conditions	No Action	LWSA	TROA
Prosser Creek	Fall/winter	28	21	21	15
	Spring/summer	28	28	28	31
Little Truckee River downstream from Stampede Reservoir	Fall/winter	53	49	49	41
	Spring/summer	16	16	16	20

5. Evaluation of Effects

a. No Action

Flushing/stranding flows occur moderately less (7 percent) often in Prosser Creek in the fall/winter months under No Action than under current conditions. Although this difference is only 7 percent, flushing/stranding flows actually occur substantially less often. There are no other effects.

b. LWSA

Flushing/stranding flows occur as frequently under LWSA as under No Action. There would be no effect.

c. TROA

Flushing/stranding flows occur moderately less often in both Prosser Creek and the Little Truckee River downstream from Stampede Reservoir in the fall/winter months under TROA than under No Action and current conditions. These tributaries are discussed individually. Tributaries with no effect are not discussed.

Flushing flows in Prosser Creek and the Little Truckee River downstream from Stampede Reservoir in the spring/summer months occur only slightly more frequently under TROA than under No Action and current conditions; this would not be a significant effect.

Prosser Creek: Under current conditions, flushing/stranding flows occur in the fall/winter months in 15 percent of years under TROA, compared to 28 percent under current conditions. Because these flows occur relatively often, this difference would be a significant beneficial effect under TROA. Operation model results show that flushing/standing flows occur nearly 30 percent less frequently in the fall/winter months under TROA than under No Action, which would be a significant beneficial effect.

Little Truckee River downstream from Stampede Reservoir: Flushing/stranding flows in the fall/winter months occur in 41 percent of years under TROA compared to 49 percent under No Action and 53 percent under current conditions. Because fall/winter flushing/ stranding flows occur relatively frequently, in about half of the years, the moderate difference in frequency under TROA would be a significant beneficial effect under TROA. In the spring/summer months, flushing/stranding flows occur 4 percent more frequently under TROA than under either No Action or current conditions. Because flushing/stranding flows occur infrequently, this would not be a significant effect on fish populations.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. A significant beneficial effect would occur in Prosser Creek and the Little Truckee River downstream from Stampede Reservoir in the fall/winter months under TROA because flushing/stranding flows would occur less frequently.

G. Frequency of Low Flows in Winter Months that Increase the Potential for Anchor Ice Formation

1. Summary of Effects

Analysis of operations model results shows that in Donner Creek and Independence Creek, low flows that increase the potential for formation of anchor ice occur substantially less often under TROA than under No Action and current conditions. The potential for formation of anchor ice would not be affected under LWSA or No Action (table 3.40).

2. Method of Analysis

The frequency of flows low enough to increase the potential for anchor ice formation from December through February (winter months), as generated by the operations model, was evaluated. Only reaches where icing is a concern were evaluated. Monthly flows were tallied if they were below minimum flows specified by CDFG and NDOW.

Table 3.40.—Summary of effects: frequency of low flows in winter months that increase the potential for anchor ice formation
(+ = significant beneficial effect, - = significant adverse effect)

River reach/tributary	Compared to current conditions			Compared to No Action	
	No Action	LWSA	TROA	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	No effect				
Truckee River from Donner Creek to Little Truckee River					
Oxbow					
Spice					
Donner Creek	No effect		+	No effect	+
Independence Creek			+		+

3. Threshold of Significance

Each reach has its own brown and rainbow trout habitat conditions and channel morphology that can dramatically influence the effects of changes in the frequency of low flows that could increase the potential for anchor ice formation on fish populations. Quantification of long-term effects of such flows is confounded by recruitment from other adjacent reaches and on-stream reservoirs. An absolute threshold value above or below which an effect is demonstrably significant, therefore, is not biologically defensible.

Interpretations of differences in the frequency of low flows that could increase the potential for anchor ice formation must be based on best professional judgment, taking into consideration not just the relative difference in the frequencies being compared but also the absolute value of those frequencies. Based on the model output, low flow conditions conducive to anchor ice formation would occur relatively rarely on the mainstem of the Truckee River with very little difference among the alternatives. In all but two cases on Donner and Independence Creek there is one percent or no difference in the frequency of such conditions. The exceptions are so marked that the likelihood of their having a significant effect on fish populations is very high.

4. Model Results

Table 3.41 presents operations model results for the frequency (percent of years) of low flows in winter months that increase the potential for anchor ice formation in selected reaches of the Truckee River and tributaries.

5. Evaluation of Effects

a. No Action

Flows low enough to increase the potential for anchor ice formation occur about as frequently (difference as of 3 percent or less) under No Action as under current conditions. There would be no effect. Tributaries with no effect are not discussed.

Table 3.41.—Frequency (percent of years) of low flows in winter months that increase the potential for anchor ice formation

River reach/tributary	Current conditions	No Action	LWSA	TROA
Truckee River from Lake Tahoe to Donner Creek	16	16	16	17
Truckee River from Donner Creek to the Little Truckee River	10	10	10	10
Oxbow	3	4	5	5
Spice	3	6	6	7
Donner Creek	12	12	12	2
Independence Creek	44	44	45	22

b. LWSA

Flows low enough to increase the potential for anchor ice formation occur about as frequently under LWSA as under No Action (differences of 1 percent or less) and as under current conditions (differences of 3 percent or less). There would be no effect. Tributaries with no effect are not discussed.

c. TROA

A significant beneficial effect would occur under TROA in Donner and Independence Creeks. The results for each of these tributaries are discussed. Tributaries with no effect are not discussed.

Donner Creek: Under TROA, flows low enough to increase the potential for anchor ice formation occur in only 2 percent of years, compared to 12 percent under both No Action and current conditions. Under TROA, therefore, fish within Donner Creek would experience substantially less mortality from icing conditions during winter, which would be a significant beneficial effect under TROA

Independence Creek: Under TROA, flows low enough to increase the potential for icing conditions occur in 22 percent of years, compared to 44 percent under both No Action and current conditions. Under TROA, therefore, fish in Donner Creek would experience substantially less mortality from icing conditions during winter, which would be a significant beneficial effect under TROA.

6. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect would occur under TROA because icing conditions would occur less frequently in Donner and Independence Creeks.

FISH IN LAKES AND RESERVOIRS

I. AFFECTED ENVIRONMENT

Native and non-native fish species occur in all of the lakes and reservoirs of the Truckee River system and in Lahontan Reservoir. Table 3.41 lists fish species found in each reservoir. Table 3.27 summarizes the spawning requirements of selected fish species in the Truckee River basin.

Nine native fish species occur in the Truckee River system, and all can occur in lakes and reservoirs in the study area. Lahontan redside shiner, speckled dace, Tahoe sucker, and tui chub are the most widespread species. Two species (cui-ui and LCT), are federally listed as endangered and threatened, respectively, and the mountain sucker is a California Species of Concern. See "Endangered, Threatened, and Other Special Status Species."

Most freshwater fish are adaptable to various habitat types, but each species has environmental limits that define its distribution. Some species, such as Lahontan redside shiner, speckled dace, and Tahoe sucker, have greater tolerance to different environmental conditions and, thus, are generally more widespread and abundant. Other species, such as mountain whitefish and mountain sucker, have more restricted environmental limits.

All native species, except mountain whitefish, spawn in spring and early summer when water temperatures are optimum for the species, flows are high, and lakes and reservoirs are filling or full. Mountain whitefish spawn in October and November when water temperatures are cold, streamflows are low, and lakes and reservoirs are lower because of summer releases.

Non-native fish species have been introduced extensively throughout the Truckee and Carson River basins, and some occur in each lake and reservoir. Twenty-five non-native fish species are found in lakes and reservoirs in the system (table 3.42). In general, all the non-native salmonids (trout and salmon), except rainbow trout, spawn in the fall and winter, and all but lake trout spawn in the Truckee River or its tributaries. The remaining non-native fish spawn in spring or early summer. They generally spawn in the lakes and reservoirs, although some can spawn in tributaries with large pools of slow, warm water.

Large fluctuations in elevation and steep slopes associated with Prosser Creek, Stampede, and Boca Reservoirs are not conducive to shallow water spawning. Lake Tahoe, Donner, Independence, and Pyramid Lakes and Lahontan Reservoir provide the best shallow water fish spawning habitat in the area since these water bodies may not have as many fluctuations in water elevation nor do they have as steep of slopes as the other reservoirs under operation.

Adequate water storage in lakes and reservoirs is important for fish survival. Primary concerns associated with low water volumes in the Truckee River basin reservoirs are increased temperatures and lack of dissolved oxygen. Higher temperatures and lower DO levels can lead to fish stress and kills.

Table 3.42.—Abundance and use of lakes and reservoirs by fish of the Truckee River system[1,2]

Species	Lake Tahoe	Donner Lake	Martis Reservoir	Prosser Reservoir	Independence Lake	Stampede Reservoir	Boca Reservoir	Pyramid Lake	Lahontan Reservoir
Native fish									
Lahontan cutthroat trout			U		C			C-P	
Mountain whitefish	U	U		U	C	U			
Paiute sculpin	C	U		U	C	U	U		
Lahontan redside shiner	C	C	U	C	C	C	C	C	U
Speckled dace	C	C	U	C	C	C	C	C	U
Lahontan tui chub	C	C		U	C	C	C	C	U
Tahoe sucker	C	C	C	C	C	C	C	C	U
Mountain sucker	U	U		U		U			U
Cui-ui								C	
Non-native fish [3]									
Rainbow trout	C-P[4]	C-P[4]	C	C-P[4]		C-P[4]	C-P[4]		
Brown trout	C-P[4]	C	C	C	U	C-P[4]	C-P[4]		
Brook trout	U				C				
Mackinaw lake trout	C	C-P				C-P			
Kokanee salmon	C-P	U-P			C	C-P	C-P		
Sacramento perch								U	C
Walleye									C-P
White bass									C-P
Largemouth bass	U								C
Smallmouth bass	U		U			C	U		
Spotted bass									U
Green sunfish			U			U	U		C
Wipers									C-P
Channel catfish									C
White catfish									C
Yellow perch									U
White crappie	U								C
Black crappie									C
Sacramento blackfish									C
Carp									C
Goldfish									U
Fathead minnow									U
Golden shiner	U								
Bullhead	U								C
Mosquitofish									C

[1] Sources: Coffin, 2003; Hiscox, 2003; Tisdale, 2003; Solberger, 2003.
[2] C = common; U = uncommon; P = planted (to maintain quality of recreational fishery).
[3] Many non-native species have become naturalized and no longer need to be planted to maintain population abundance.
[4] Reproducing populations may also be present.

Extensive algal blooms may occur in Lahontan Reservoir when water storage is low. Fish kills sometimes occur in summer when water elevations are low and blooms of the blue-green alga, *Aphanizomenon flos-aquae*, occur (NDOW, 1992a). When green and blue-green algae are active, they produce oxygen; when they decompose, they consume oxygen. Rapid decomposition, which may occur following large blooms, may adversely affect invertebrates and fish and lead to fish kills by reducing the amount of dissolved oxygen available for respiration. Fish kills at Lahontan Reservoir may also have resulted from the toxins produced by *Aphanizomenon* and not oxygen depletion. However, blooms may not develop if wind produces wave action on the open water or if mechanical aeration systems are activated.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

To evaluate the effects of changes in reservoir and lake storage on resident fish, the following two indicators were selected:

1. Fish survival based on minimum storage thresholds.
2. Spring/summer shallow water fish spawning habitat

B. Summary of Effects

Table 3.43 summarizes the effects on fish in lakes and reservoirs.

Table 3.43.—Summary of effects: fish in lakes and reservoirs
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">Lake/reservoir</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td colspan="6">Fish survival</td></tr>
<tr><td>Prosser Creek</td><td colspan="3">+</td><td rowspan="3">No effect</td><td rowspan="3">+</td></tr>
<tr><td>Stampede</td><td colspan="2" rowspan="2">No effect</td><td rowspan="2">+</td></tr>
<tr><td>Boca</td></tr>
<tr><td>Lahontan</td><td colspan="5">No effect</td></tr>
<tr><td colspan="6">Spring/summer shallow water fish spawning habitat</td></tr>
<tr><td>Tahoe</td><td colspan="5" rowspan="5">No effect</td></tr>
<tr><td>Donner</td></tr>
<tr><td>Independence</td></tr>
<tr><td>Pyramid</td></tr>
<tr><td>Lahontan</td></tr>
</table>

C. Fish Survival Based On Minimum Storage Thresholds

1. Method of Analysis

For the fish survival analysis, minimum storage thresholds (thresholds) were assigned and analyzed for Prosser Creek, Stampede, Boca, and Lahontan Reservoirs. CDFG and NDOW have recommended thresholds for these reservoirs to maintain fisheries, water quality, and aquatic productivity. The conservation pool threshold in Lahontan Reservoir, agreed to by TCID in 1992, is recommended to minimize algal blooms. The established thresholds are as follows:

- Prosser Creek Reservoir: 5,000 acre-feet minimum
- Stampede Reservoir: 15,000 acre-feet minimum
- Boca Reservoir: 10,000 acre-feet minimum
- Lahontan Reservoir: 4,000 acre-feet minimum

The analysis for fish survival evaluated the probability (frequency) that storage in these four reservoirs falls below thresholds at least once during the year, as shown by operations model results. The analysis assumes that the greater the storage throughout the year, the greater the fish productivity, and that fish survival is likely to be adversely affected the more frequently storage is below these thresholds.

2. Threshold of Significance

Fish populations at Prosser Creek, Stampede, Boca, and Lahontan Reservoirs could be adversely affected if reservoir storage were to fall below the thresholds recommended to maintain fish populations, water quality, and aquatic productivity at a sufficient frequency and magnitude, relative to current conditions or No Action, to significantly affect fish survival. The significance of differences was based on best professional judgment.

3. Model Results

Table 3.44 presents operations model results for the frequency (percent of years) that storage in the reservoirs falls below the recommended thresholds.

Table 3.44.—Frequency (percent of years) that storage in reservoirs falls below the recommended thresholds

Lake/reservoir	Current conditions	No Action	LWSA	TROA
Prosser Creek	41	20	20	11
Stampede	15	11	14	2
Boca	90	88	89	55
Lahontan	16	16	16	16

4. Evaluation of Effects

a. No Action

i. Prosser Creek Reservoir

Operations model results show that Prosser Creek Reservoir falls below the threshold in about half as many years under No Action as under current conditions. This would result in a substantial decrease in fish mortality and would be significant beneficial effect under No Action when compared to current conditions.

ii. Stampede Reservoir

Stampede Reservoir falls below the threshold in only 4 percent fewer years under No Action than under current conditions. There would be no effect.

iii. Boca Reservoir

Boca Reservoir falls below the threshold in 2 percent fewer years under No Action than under current conditions. There would be no effect.

iv. Lahontan Reservoir

Lahontan Reservoir falls below the threshold as frequently under No Action as under current conditions. There would be no effect.

b. LWSA

i. Prosser Creek Reservoir

Prosser Creek Reservoir falls below the threshold as frequently under LWSA as under No Action. There would be no effect. The reservoir falls below the threshold in about half as many years under LWSA as under current conditions, which would be significant beneficial effect under LWSA when compared to current conditions.

ii. Stampede Reservoir

Stampede Reservoir falls below the threshold in only 3 percent more years under LWSA than under No Action. There would be no effect. The reservoir falls below the threshold about as frequently under LWSA as under current conditions (difference of only 1 percent). This small difference would not be significant.

iii. Boca Reservoir

Boca Reservoir falls below the threshold about as frequently under LWSA as under No Action or current conditions (differences of 1 percent). These small differences would not be a significant effect.

iv. Lahontan Reservoir

Lahontan Reservoir falls below the threshold as frequently under LWSA as under No Action or current conditions. There would be no effect.

c. TROA

i. Prosser Creek Reservoir

Prosser Creek Reservoir falls below the threshold in about half as many years under TROA as under No Action. This would result in a substantial decrease in fish mortality and would be a significant beneficial effect under TROA when compared to No Action.

Prosser Creek Reservoir falls below the threshold in nearly 30 percent fewer years under TROA than under current conditions. This would result in a substantial decrease in fish mortality and would be a significant beneficial effect under TROA when compared to current conditions.

ii. Stampede Reservoir

Stampede Reservoir falls below the threshold in 9 percent fewer years than under No Action. This would result in a substantial decrease in fish mortality and would be significant beneficial effect under TROA when compared to No Action.

Stampede Reservoir falls below the threshold in nearly 13 percent fewer years under TROA than under current conditions. This would result in a substantial decrease in fish mortality and would be a significant beneficial effect under TROA when compared to current conditions.

iii. Boca Reservoir

Boca Reservoir falls below the threshold in 33 percent fewer years under TROA than under No Action. This would result in a substantial decrease in fish mortality and would be a significant beneficial effect under TROA when compared to No Action.

Boca Reservoir falls below the threshold in 35 percent fewer years under TROA than under current conditions. This would result in a substantial decrease in fish mortality and would be a significant beneficial effect under TROA when compared to current conditions.

iv. Lahontan Reservoir

Lahontan Reservoir falls below the threshold as frequently under TROA as under No Action and current conditions. There would be no effect.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect would occur under TROA because storage in Prosser Creek, Stampede, and Boca Reservoirs would fall below the thresholds substantially less often than under No Action or current conditions.

D. Spring/Summer Shallow Water Fish Spawning Habitat

1. Method of Analysis

The shallow water fish spawning habitat analysis compared the amount of available fish spawning habitat under current conditions, No Action, LWSA, and TROA based on operations model results. Spring and summer shallow water fish spawning habitat was measured by the average acres of shallow (i.e., less than 1 meter (3.28 feet) deep) water habitat in Lake Tahoe and Donner and Independence Lakes in June in wet, median, and dry hydrologic conditions. The use of wet, median, and dry hydrologic conditions is not applicable in analysis of Pyramid Lake because it is a terminal lake. The total area in wet, median, and dry hydrologic conditions, therefore, does not correlate with these hydrologic conditions due to the general trend for the water elevation of Pyramid Lake to increase from current conditions under all alternatives. The Pyramid Lake analysis uses the average total acres of shallow water habitat in June over the modeled 100-year period. June was chosen as a representative month for fish that spawn in spring and summer in the basin because, although the spawning season for the various fish species may cover different time periods in the spring and summer, the majority of fish spawn in June.

A separate analysis was conducted for spring and summer fish spawning at Lahontan Reservoir. NDOW recommends a minimum storage threshold of 160,000 acre-feet at Lahontan Reservoir in May and June to benefit fish spawning. Below this threshold, rocky substrate important for spawning and cover for young fish becomes limited (BOR, 1986; Sevon, 1993). The analysis for spring and summer fish spawning at Lahontan Reservoir evaluated the frequency that the storage falls below this threshold in May and June under current conditions and the alternatives.

2. Threshold of Significance

An effect on fish populations at Lake Tahoe and Donner, Independence, and Pyramid Lakes were considered significant if a change in shallow water habitat of 15 percent or more were to occur in June, as shown by operations model results. An effect on fish populations at Lahontan Reservoir was considered significant if storage were to fall below the recommended threshold (160,000 acre-feet) 15 percent or more frequently in May and June, as shown by operations model results.

3. Model Results

Table 3.45 presents operation model results for the average total area in acres of shallow water fish spawning habitat in June in wet, median, and dry hydrologic conditions at Lake Tahoe and Donner and Independence Lakes. Table 3.46 presents operations model results for the average total area of shallow water fish spawning habitat in June at Pyramid Lake. Table 3.47 presents operations model results for the frequency that Lahontan Reservoir falls below 160,000 acre-feet in May and June.

Table 3.45.—Average total area (acres) of shallow water fish spawning habitat in June in wet, median, and dry hydrologic conditions at Lake Tahoe and Donner and Independence Lakes

Lake	Hydrologic condition	Current conditions	No Action	LWSA	TROA
Tahoe	Wet	1,301	1,301	1,301	1,301
	Median	1,292	1,291	1,291	1,292
	Dry	715	715	715	722
Donner	Wet	38	38	38	38
	Median	38	38	38	38
	Dry	33	33	33	33
Independence	Wet	29	29	29	29
	Median	29	29	29	29
	Dry	25	26	26	24

Table 3.46.—Average total area (acres) of shallow water fish spawning habitat in June at Pyramid Lake

Current conditions	No Action	LWSA	TROA
1,675	1,663	1,664	1,666

Table 3.47.—Frequency that Lahontan Reservoir falls below 160,000 acre-feet in May and June

Current conditions	No Action	LWSA	TROA
16	18	18	20

4. Evaluation of Effects

a. No Action

i. Lake Tahoe

Operations model results show that the average total area of shallow water fish spawning habitat at Lake Tahoe is about the same under No Action as under current conditions in all three hydrologic conditions (maximum difference of 1 acre). There would be no significant effect.

ii. Donner Lake

The average total area of shallow water fish spawning habitat at Donner Lake is the same under No Action as under current conditions in all three hydrologic conditions. There would be no effect.

iii. Independence Lake

The average total area of shallow water fish spawning habitat at Independence Lake is about the same under No Action as under current conditions in all three hydrologic conditions (maximum difference of 1 acre). There would be no significant effect.

iv. Pyramid Lake

The average total area of shallow water fish spawning habitat at Pyramid Lake is about the same under No Action as under current conditions (difference of less than 1 percent) in all three hydrologic conditions. There would be no significant effect.

v. Lahontan Reservoir

Lahontan Reservoir falls below 160,000 acre-feet 2 percent more frequently under No Action than under current conditions. There would be no significant effect.

b. LWSA

i. Lake Tahoe

The average total area of shallow water fish spawning habitat at Lake Tahoe is the same under LWSA as under No Action in all three hydrologic conditions and is about the same as under current conditions (difference of 1 acre in median hydrologic conditions). There would be no significant effect.

ii. Donner Lake

The average total area of shallow water fish spawning habitat at Donner Lake is the same under LWSA as under No Action and current conditions in all three hydrologic conditions. There would be no effect.

iii. Independence Lake

The average total area of shallow water fish spawning habitat at Independence Lake is the same under LWSA as under No Action in all hydrologic conditions and is about the same as under current conditions (difference of 1 acre in dry hydrologic conditions). There would be no effect.

iv. Pyramid Lake

The average total area of shallow water fish spawning habitat at Pyramid Lake is about the same under LWSA as under No Action and current conditions (differences of less than 1 percent). There would be no effect.

v. Lahontan Reservoir

Lahontan Reservoir falls below 160,000 acre-feet as frequently under LWSA as under No Action and 2 percent more frequently than under current conditions. There would be no significant effect.

c. TROA

i. Lake Tahoe

The average total area of shallow water fish spawning habitat at Lake Tahoe is the same under TROA as under No Action and current conditions in wet hydrologic conditions and is about the same in median and dry hydrologic conditions (differences of less than 1 percent). There would be no effect.

ii. Donner Lake

The average total area of shallow water fish spawning habitat at Lake Tahoe is the same under TROA as under No Action and current conditions in any hydrologic condition. There would be no effect.

iii. Independence Lake

The average total area of shallow water fish spawning habitat at Independence Lake is the same under TROA and No Action in wet and median hydrologic conditions and differs by less than 8 percent in dry hydrologic conditions. It is the same under TROA as under current conditions, except in dry hydrologic conditions (difference of only 1 acre). There would be no effect. TROA would allow for water exchange among reservoirs and provide greater flexibility in the management of Independence Lake to limit or increase fish spawning habitat.

iv. Pyramid Lake

The average total area of shallow water fish spawning habitat at Pyramid Lake is less than 1 percent less under TROA than under No Action or current conditions. There would be no effect.

v. Lahontan Reservoir

Lahontan Reservoir falls below 160,000 acre-feet 2 percent more frequently under TROA than under No Action and 4 percent more frequently than under current conditions. These small differences are not enough to pose a threat to fish populations in Lahontan Reservoir. Most fish species that spawn in Lahontan Reservoir are introduced, many are planted, and none are imperiled. No significant effect, therefore, would occur.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

WATERFOWL AND SHOREBIRDS

I. AFFECTED ENVIRONMENT

Waterfowl and shorebirds that use lakes and reservoirs in the Truckee River basin are listed in the Biological Resources Appendix. In general, habitat at reservoirs is of lower quality and provides less plant and animal food for water birds than do natural (i.e., unregulated) lakes and ponds; this may be because fluctuating elevations inhibit the establishment and development of shoreline vegetation that many birds require (Beedy and Granholm, 1985). Lake Tahoe, Pyramid Lake, Lahontan Reservoir, and, to a lesser extent, Stampede Reservoir, provide large quantities of more stable, higher quality habitat that supports the largest populations of waterfowl in the study area. Stampede and Lahontan Reservoirs and Pyramid Lake also have islands where many bird species nest. Donner and Independence Lakes and Prosser Creek and Boca Reservoirs provide relatively limited habitat because of their small size, high recreational use, or widely fluctuating water elevations. During summer months, water bird use at many of the lakes and reservoirs is limited due to human recreation activities.

Common water bird species at Lake Tahoe include Canada geese, California gulls, mallards, and mergansers. The lake is used by various migrating waterfowl and shorebirds. The number of nesting birds has greatly decreased with development of the shoreline (Orr and Moffitt, 1971).

Stampede Reservoir provides foraging habitat for migrating waterfowl. Canada goose is the primary island nesting species at Stampede Reservoir; nesting occurs from March through May.

Lahontan Reservoir is used by dabbling ducks, especially during the fall, and is an important nesting and feeding area for Canada geese (Saake, 1994). American white pelicans also use Lahontan Reservoir during the spring, particularly when lakes and ponds at Stillwater National Wildlife Refuge and other Lahontan Valley wetlands are reduced during drought years. Waterbird nesting occurs on Gull and Evans Islands in Lahontan Reservoir. Colonial nesting species, such as California and ring-billed gulls; double-crested cormorant; great blue heron; snowy, great, and cattle egrets; and black-crowned night heron, nest on these islands from March through July (Neel, 1995).

Of the 51 water bird species that occur at Pyramid Lake, 29 species (excluding shorebirds) potentially breed at or near the lake; 10 of these species are winter visitors, and 12 are transients during fall and spring migration (Biological Resources Appendix). Waterfowl use at Pyramid Lake is greatest during the fall and winter. Pyramid Lake is especially important waterfowl habitat in drought years when other wetlands are dry. Anaho Island in Lake Pyramid provides nesting habitat for many bird species. The northern end of Pyramid Lake, which provides shallow feeding areas and is less disturbed by recreationists, and the southern end near the mouth of the Truckee River, are the most important feeding areas for waterfowl.

Table 3.48 presents 2003 survey data for wintering waterfowl within the four counties that include lakes and reservoirs in the study area in Nevada. The numbers included in this table are likely higher than the actual number of waterfowl using the major water bodies within the study area because the survey was county-wide; data for two wildlife management areas within the four counties but not part of this analysis are not included in the numbers shown in the table.

Table 3.48.—Number of waterfowl counted during 2003 FWS mid-winter inventories of all major wetlands in Douglas County (Lake Tahoe), Lyon County (Lahontan Reservoir), Churchill County (Lahontan Reservoir) and Washoe County (Lake Tahoe and Pyramid Lake), Nevada

	Douglas Co.	Lyon Co.	Churchill Co.[1]	Washoe Co.[2]	Total
Dabbling ducks	1,020	1,645	18,436	6,114	27,215
Diving ducks	110	497	4,946	2,493	8,046
Geese	1,530	2,250	1,650	8,964	14,394
Swans	14	41	180	410	645
Coots	130	1,170	7,180	2,217	10,697
Total	2,804	5,603	32,392	20,198	60,997

[1] Churchill County data does not include waterfowl inventoried at Stillwater WMA.
[2] Washoe County data does not include waterfowl inventoried at Scripps Management Area.

II. Environmental Consequences

A. Introduction

Modifying operations of Truckee River reservoirs could affect lake and reservoir elevations. In turn, reservoir elevations could affect waterfowl, shorebirds, and island-nesting birds in the study area. This analysis evaluated the effects of changes in water elevations on these bird guilds using following indicators:

1. Waterfowl and shorebird shallow water foraging habitat
2. Island bird nest predation and inundation

B. Summary of Effects

At Stampede Reservoir, analysis of operations model results shows that predator access to islands on which birds nest occurs less frequently under TROA than under No Action and current conditions (table 3.49). This beneficial effect would be offset, however, by the greater probability that the island would be inundated. The difference is not significant compared to No Action, but would have a significant adverse effect on the potential for local nesting success by Canada geese when compared to current conditions. This local adverse effect is not significant to the overall regional population of Canada geese and would require no mitigation.

Table 3.49.—Summary of effects: waterfowl and shorebirds
(+ = significant beneficial effect, - = significant adverse effect)

Lake/reservoir	Compared to current conditions			Compared to No Action	
	No Action	LWSA	TROA	LWSA	TROA
Waterfowl and shorebird shallow water foraging habitat					
Tahoe	No effect				
Stampede	No effect			No effect	+
Pyramid	No effect				
Lahontan					
Island bird nest predation and inundation					
Stampede	No effect		-	No effect	
Lahontan	No effect				

At Lahontan Reservoir, predator access to islands on which birds nest occurs slightly more frequently under TROA, but the difference is too small to constitute a significant adverse effect.

C. Waterfowl and Shorebird Shallow Water Foraging Habitat

1. Method of Analysis

Shallow water foraging habitat for waterfowl and shorebirds, for the purpose of this analysis, is the total area of water less than 18 inches deep along the shoreline of lakes and reservoirs. This water depth was selected because the foraging habitat of most waterfowl and shorebird species is not deeper than 18 inches (Jasmer, 2000; Biological Resources Appendix). Lake Tahoe, Stampede and Lahontan Reservoirs, and Pyramid Lake are the only lakes and reservoirs in the study area frequently used by large numbers of water birds, so only these lakes and reservoirs were evaluated. The amount of year-round foraging habitat was estimated for Lake Tahoe and Lahontan Reservoir, given their use by wintering, migrating, and breeding waterfowl. The amount of foraging habitat from February through October was estimated for Stampede Reservoir, because it is primarily used by migrating and, to a lesser degree, breeding waterfowl. The amount of foraging habitat for Pyramid Lake from September through January, the period of use by wintering waterfowl, was evaluated.

Operations model results were used to measure the total area of waterfowl and shorebird shallow water foraging habitat available in wet, median, and dry hydrologic conditions at Lake Tahoe and Stampede and Lahontan Reservoirs by averaging the number of acres of water less than 18 inches during the period of use. The use in wet, median, and dry hydrologic conditions is not applicable in analysis of Pyramid Lake because it is a terminal lake. The total area in wet, median, and dry hydrologic conditions, therefore, does not correlate with these hydrologic conditions because of the general trend for the elevation of Pyramid Lake to increase from current conditions under all alternatives. The Pyramid Lake analysis used the average total acres of shallow water habitat less than 18 inches deep over the modeled 100-year period.

2. Threshold of Significance

A change in the average total area of shallow water foraging habitat of 15 percent or greater during the period of use at Lake Tahoe, Pyramid Lake, and Lahontan and Stampede Reservoirs was considered significant. This assessment was based on the output of the operations model and best professional judgment.

3. Model Results

Table 3.50 presents operations model results for shallow water foraging habitat at Lake Tahoe and Stampede and Lahontan Reservoirs. Table 3.51 presents operations model results for shallow water foraging habitat at Pyramid Lake.

Table 3.50.—Average total area (acres) of shallow water foraging habitat for waterfowl and shorebirds in wet, median, and dry hydrologic conditions during the period of use at Lake Tahoe and Stampede and Lahontan Reservoirs

Lake/reservoir	Period of use	Hydrologic condition	Current conditions	No Action	LWSA	TROA
Tahoe	Year-round	Wet	774	774	774	790
		Median	593	588	587	617
		Dry	326	326	326	326
Stampede	February-October	Wet	48	48	48	48
		Median	43	43	43	43
		Dry	23	26	26	41
Lahontan	Year-round	Wet	997	1,012	1,012	1,012
		Median	359	351	351	354
		Dry	217	201	200	201

Table 3.51.—Average total area (acres) of shallow water foraging habitat for waterfowl and shorebirds from September through January at Pyramid Lake

Current conditions	No Action	LWSA	TROA
765	759	757	764

4. Evaluation of Effects

a. No Action

Operations model results show that, with a few exceptions, less shallow water foraging is available habitat under No Action than under current conditions. The differences are less than 2 percent, except in dry hydrologic conditions when 7 percent less habitat is available under No Action than under current conditions. None of the differences would be a significant effect.

b. LWSA

In most cases, less shallow water foraging habitat is available under LWSA than under either No Action or current conditions. The differences are always 1 percent or less. Such small differences would not constitute a significant effect.

The differences between LWSA and current conditions are also small. All differences are less than 2 percent, except in dry hydrologic conditions, when LWSA differs from current conditions by 8 percent. None of the differences would constitute a significant effect.

c. TROA

Operation model results show the same or more shallow water foraging habitat under TROA as under No Action at all lakes and reservoirs. Most differences are less than 5 percent, too small to be considered significant. At Stampede Reservoir in dry hydrologic conditions, however, nearly 60 percent more shallow water foraging habitat is available under TROA than under No Action, which would be significant beneficial effect.

The same or more shallow water foraging habitat is available under TROA as under current conditions at most lakes and reservoirs in most hydrologic conditions. All differences are less than 5 percent, too small to be considered significant. At Stampede Reservoir in dry hydrologic conditions, however, nearly 80 percent more shallow water habitat is available under TROA than under current conditions, which would be significant beneficial effect.

Less habitat is available under TROA than under current conditions at Lahontan Reservoir in median and dry hydrologic conditions; the differences are less than 2 and 8 percent, respectively, and do not constitute a significant effect. One fewer acre is available at Pyramid Lake under TROA than under No Action; this also would not be a significant effect.

The greatest effect on shallow water foraging habitat occurs in dry hydrologic conditions at Lahontan Reservoir, where up to 8 percent less habitat is available under No Action, LWSA, and TROA than under current conditions. Such small and infrequent differences in habitat would not be significant because they are unlikely to affect populations of waterfowl and shorebirds over the long-term. Although such habitat decreases may affect local bird populations in dry periods, the populations can be expected to rebound as hydrologic conditions change and the amount of habitat increases.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect would occur under TROA because more shallow water foraging habitat for waterfowl and shorebirds would be available at Stampede Reservoir in dry hydrologic conditions.

D. Island Bird Nest Predation and Inundation

1. Method of Analysis

Fluctuating lake and reservoir elevations can impair breeding success of birds. Lower elevations may allow predator access to nesting islands, while higher elevations may inundates nests. Contour intervals were used to estimate the water elevation at which a landbridge could make water bird nesting islands accessible to mainland predators. Getz and Smith (1989) recommend a distance of approximately 200 to 500 feet between an island and mainland and minimum water depths of 2 to 3.5 feet to reduce predation losses from canines. The island in Stampede Reservoir and the two islands in Lahontan Reservoir are accessible to mainland predators at elevations lower than 5880, 4142, and 4127 feet, respectively. Anaho Island in Pyramid Lake could be accessed by predators if the elevation were to drop below 3795 feet. No other lakes or reservoirs in the system have islands that could be accessed by mainland predators. The island in Stampede Reservoir becomes inundated above elevation 5940 feet, thereby eliminating waterfowl nesting on the island. Gull and Evans Islands in Lahontan Reservoir are above the spillway elevation of Lahontan Dam, and inundation of Anaho Island is highly unlikely because of its height above the current elevation of Pyramid Lake.

Operations model results showing surface water elevation were used to determine the frequency (percent of years) that predator access could occur during at least 1 month in the nesting season at islands in Stampede and Lahontan Reservoirs and Pyramid Lake. These data were also used to examine the frequency (percent of years) that the island in Stampede Reservoir could be inundated during at least 1 month in the nesting season. Operations model results show that Pyramid Lake never falls below the landbridge threshold elevation of 3795 feet under current conditions or the alternatives; therefore, there is no further discussion of predator access to Anaho Island.

If predation or inundation were to occur early in the nesting season, island nesting birds could re-nest if conditions improve later in the nesting season. The potential for re-nesting is unknown and is not considered in this analysis, which examines only if unfavorable island nesting conditions occur during in 1 month of the nesting season.

2. Threshold of Significance

An analysis of historical lake elevation data from 1939 to 1996 shows that Gull Island, the main nesting island in Lahontan Reservoir, has been landbridged in 26 percent of the years during the gull nesting season. Evans Island, the smaller island where a fewer bird species nest, has been landbridged in 7 percent of these years. Despite past landbridging, island nesting birds continue to breed successfully at Lahontan Reservoir. A significant effect could potentially occur if, based on operations model results, there is a change in the frequency that predator access to island nests during the nesting season (March through July). The significance of any effect was based on best professional judgment in considering the results of the operations model.

A significant effect could occur at Stampede Reservoir if operations model results show a change in the frequency that access by mammalian predators to, or inundation of, the island at Stampede Reservoir during the Canada geese nesting season (March through May). The significance of any effect was based on best professional judgment in considering the results of the operations model.

3. Model Results

Table 3.52 presents operations model results for the frequency (percent of years) of predator access to nesting islands in Stampede and Lahontan Reservoirs. Table 3.53 presents operations model results for the frequency (percent of years) of inundation of island nests at Stampede Reservoir.

Table 3.52.—Frequency (percent of years) of predator access to nesting islands in Stampede and Lahontan Reservoirs

Reservoir	Current conditions	No Action	LWSA	TROA
Stampede	19	22	22	10
Lahontan – Gull Island	25	26	26	26
Lahontan – Evans Island	8	9	9	10

Table 3.53.—Frequency (percent of years) of inundation of island nests at Stampede reservoir

Current conditions	No Action	LWSA	TROA
56	57	58	70

4. Evaluation of Effects

a. No Action

Operations model results show that predator access to islands in Stampede and Lahontan Reservoirs occurs about as frequently under No Action as under current conditions (differences of 3 percent and 1 percent, respectively). Island nests in Stampede Reservoir are inundated 1 percent more frequently under No Action than under current conditions. Such small differences would be unlikely to have long-term effects on populations of island-nesting birds and, therefore, would not be a significant effect.

b. LWSA

Predator access to islands in Stampede and Lahontan Reservoirs and inundation of island nests in Stampede Reservoir occur as frequently under LWSA as under No Action. Effects would be the same as under No Action.

c. TROA

Predator access to islands in Lahontan Reservoir occurs as frequently under TROA as under No Action. Effects would be the same as under No Action.

Predator access to the island in Stampede Reservoir occurs about 50 percent less frequently under TROA than under No Action or current conditions, which would be a significant beneficial effect.

Island nests in Stampede Reservoir are inundated 13 percent more frequently under TROA than under No Action and 14 percent more frequently than under current conditions. These differences must, however, be weighed against the less frequent predator access to the same island under TROA. Operations model results show that under TROA, predators would have access to the island 10 out of 100 years, while the island would be inundated 70 years, resulting in 20 years conducive to nesting success. Under No Action, predators would have island access 22 years, while the island would be inundated in 57 years, resulting in 21 years conducive to nesting success. Under current conditions, predators could access the island in 19 years, while it would be inundated in 56 years, resulting in 25 years conducive to nesting success. The net effect of TROA, therefore, is a 5-percent reduction compared to No Action and a 20-percent reduction compared to current conditions. While it is possible that either of these reductions could have an adverse effect on local Canada goose nesting success, no significant adverse effect is expected to the regional population. Canada geese are one of the most common waterfowl in the study area. Geese could nest at many other locations in the Truckee River basin when conditions are unfavorable at Stampede Reservoir. Moreover, resident Canada geese present a management problem in many urban areas, including Reno-Sparks.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects on island nesting birds at Lahontan and Stampede Reservoirs would occur under any of the alternatives.

RIPARIAN HABITAT AND RIPARIAN-ASSOCIATED WILDLIFE

I. AFFECTED ENVIRONMENT

Riparian (i.e., along rivers or streams) habitats, because of their moisture gradients, their dynamic response to river processes, and their long complex interfaces between both upland and aquatic habitats, are among the most diverse and biologically productive ecosystems (Naimann et al., 1993). This is particularly true in arid areas such as the Western United States; for example, an investigation on the Inyo National Forest found that riparian areas comprised less than 0.4 percent of the land area but were essential habitat for about 75 percent of local wildlife species (Kondolf et al., 1987).

Riparian vegetation (the plants growing along a stream) plays an important role in riverine ecosystems. Plant roots help stabilize soil, and stems and leaves of emergent vegetation (plants rooted in water) move with the current, decreasing flow velocity and reducing the scouring effects of water. Shade produced by overhanging vegetation helps maintain the cool water temperatures critical for many fish species. Riparian vegetation traps sediment from the watershed, preventing it from settling on food producing areas, spawning sites, fish eggs and fry, and insect larvae. Emergent vegetation provides cover as well as a substrate for organisms and eggs.

Modifying operations of Truckee River reservoirs and the resulting effect on flows could affect the abundance, distribution, and condition of riparian vegetation (Kattelmann and Embury, 1996). During periods of higher flow, portions of the flood plain may be inundated, revitalizing riparian vegetation in those areas. High flow can also remove vegetation and create the mineral surfaces that some riparian plants need for seed germination. Extremely high flow, such as occurs during large storm events, may scour the stream channel of established vegetation.

During periods of low flow, particularly if prolonged, riparian vegetation may dry out, shed its leaves, and lose vigor. Some plants may die, reducing habitat for wildlife. Low flows in spring and early summer may not provide sufficient water for seed germination and seedling growth in areas away from the streambed.

Other factors, such as irrigation, runoff from upland areas, and seepage of water from streambanks also affect riparian vegetation. Changes in vegetation composition and structure that result from changes in streamflow often are not immediately obvious and may not become evident for months or even years.

A. Riparian Habitat

The Truckee River originates within mixed conifer-forested mountains and descends to arid shrub-dominated valleys. Over this distance of about 120 miles, the river descends in elevation by over 2,000 feet. The transition zone from montane forest to shrubland begins in the vicinity of the town of Truckee and is not complete until the river reaches the outskirts of Reno, a distance of roughly 35 miles. This broad transition zones marks a shift in flora and fauna between the Mediterranean climate of California and the interior continental climate of the Great Basin (Manley et al., 2000). The obvious shift from forest to shrubland is paralleled by a more subtle change in the structure and composition of riparian vegetation along the Truckee River. The montane riparian forest typified by black cottonwood and pine with an alder-willow understory merges gradually to the Great Basin riparian forest of Fremont’s cottonwood and willow shrub, or stands of shrubby willow lacking trees (Caicco, 1998). This great diversity in riparian and upland vegetation along the Truckee River provides a wide variety of habitats for riparian-associated wildlife.

There is no comprehensive list of plant species for the entire Truckee River basin. A recent analysis concluded that the Lake Tahoe basin alone has at least 1,553 vascular and nonvascular plant taxa (Manley et al., 2000). This total excludes many Great Basin plant species that are not found in the Lake Tahoe basin. The total number of riparian plant species along the Truckee River and its tributaries, nevertheless, is likely to be considerably smaller than the total found in the entire Lake Tahoe basin.

Riparian areas along the Truckee River and its tributaries have been affected by a wide variety of human activities and natural disturbances, including grazing by domestic livestock, timber harvest, highway and railroad construction, urban and industrial development, clearing for agricultural uses, invasion by nonnative plant species, fire, landslides, and water impoundment, diversion, and management (Kattelmann and Embury, 1996; Caicco, 1998; Manley et al., 2000). The extent of riparian habitat and land use types found along the Truckee River was mapped from aerial photographs taken in November 1991 (FWS, 1995a). From these maps, the area of various types was calculated (table 3.54). Mapping was restricted to the flood plain and a narrow band of contiguous upland between Lake Tahoe and Marble Bluff Dam. The area of riparian vegetation type along the upper basin tributaries was calculated from National Wetlands Inventory maps (table 3.55).

Three general types in wetlands potentially affected by changes in reservoir operations occur within the study area: palustrine emergent wetlands; palustrine scrub-shrub wetlands; and palustrine forested wetlands. These are discussed in the following sections.

1. Palustrine Emergent Wetlands

Palustrine emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes (i.e., plants adapted to live in very wet habitats, often called emergent vegetation; Cowardin et al., 1979). Such wetlands are dominated by grasses, bulrushes, sedges, and rushes. Two general types of palustrine emergent wetlands occur in the Truckee River system: montane freshwater marshes/wet meadows, generally found upstream of Verdi; and transmontane freshwater marsh, found downstream from Verdi (Caicco 1998; FWS, 1993; Holland, 1986; FWS, 1995a).

Table 3.54.—Riparian and wetland habitats (in acres) along the mainstem of the Truckee River[1]

Riparian and wetland habitats	Lake Tahoe to Boca Reservoir	Boca Reservoir to State line	State line to Vista	Vista to Derby Diversion Dam	Derby Diversion Dam to Wadsworth	Wadsworth to Dead Ox Wash	Dead Ox Wash to Numana Dam	Numana Dam to Marble Bluff Dam	Marble Bluff Dam to Pyramid Lake[2]
Riverine	160	117	219	192	94	70	47	66	38
Pond-like areas[3]	0	0.5	0.5	0	0.2	6	0.2	0.7	0
Ponds	0	0	0.02	0.5	5	0	0	0.8	0
Montane black cottonwood riparian forest	8	81	119	0	0	0	0	0	0
Modoc-Great Basin cottonwood-willow riparian forest	0	0	75	79	105	152	0	79	1
Montane riparian scrub	114	110	0	0	0	0	0	0	0
Modoc-Great Basin riparian scrub	0	0	224	76	106	172	8	184	11
Montane freshwater marsh	5	0	0	0	0	0	0	0	0
Transmontane freshwater marsh	0	0	0.3	5	0	10	5	10	0

[1] Source: FWS, 1995a.
[2] Acreage determined by Reno State Office staff from November 4, 1991, aerial photography and field checked July 1994.
[3] Pond-like areas believed to be hydrologically influenced by the Truckee River.

Table 3.55.—Riparian habitats[1] along upstream tributaries to the Truckee River

Tributary	Acres of palustrine wetlands		
	Emergent[2]	Scrub-shrub[3]	Forested[4]
Donner Creek	2	18	0
Prosser Creek	0	4	0
Independence Creek	0.3	22	4
Little Truckee River Independence Creek to Stampede Reservoir	121	11	12
Little Truckee River Stampede Reservoir to Boca Reservoir	78	21	0
Little Truckee River Boca Reservoir to Truckee River	0	0	0

[1] Acres planimetered from FWS National Wetlands Inventory maps (1984).
[2] Palustrine emergent (Cowardin et al., 1979) includes montane freshwater marsh of Holland (1986).
[3] Palustrine scrub-shrub (Cowardin et al., 1979) includes montane riparian scrub of Holland (1986).
[4] Palustrine forested (Cowardin et al., 1979) includes montane black cottonwood riparian forest and mixed pine forest of Holland (1986).

Emergent wetland and other herbaceous vegetation along the edges of rivers and streams commonly expands into the exposed river channel during periods of low flow. Higher flow may scour the emergent vegetation from the stream channel. The total area of emergent vegetation, therefore, can vary considerably in response to flow. A single storm event may produce flow large enough to result in a substantial decrease in the total area of emergent vegetation. The Biological Resources Appendix includes further discussion on the relation between streamside emergent vegetation, vegetated streambeds, and gravel bars.

2. Montane Freshwater Marshes/Wet Meadows

Within the study area, these habitats are generally restricted to a few small islands of vegetation between Tahoe City and the town of Truckee and to bands of vegetation along banks of the Truckee and Little Truckee Rivers. Several ecologically significant marshes occur at the mouths of tributaries at south end of Lake Tahoe (Manley et al., 2000). Smaller marshes or wet meadows also occur at the mouths of tributaries that empty into lakes, reservoirs, and the main stem of the Truckee River. These areas are typically dominated by dense perennial, emergent vegetation. Common plant species include slender-beak sedge, water sedge, and beaked sedge.

The restricted distribution of emergent vegetation and the prevalence of plant species that require a high water table indicate the habitat cannot tolerate extended periods of drought. Such habitats are inundated annually when streamflows are 100 cfs or greater, although annual inundation is not required for all plant species to persist. Flows of 500 cfs or greater may scour emergent plants from the river channel and restrict them to a narrow band along the banks; such streamflows occur about once every 1.5 years (FWS, 1993). The Biological Resources Appendix provides further discussion on frequency of inundation of this habitat.

3. Transmontane Freshwater Marsh

This habitat, which is structurally similar to montane freshwater marsh, also requires frequent inundation or a high water table. It is restricted to small areas and narrow bands of streambank vegetation downstream from Verdi and to a few low-lying areas away from the active steam channel where it may persist due to irrigation runoff or seasonal ponding.

Although no data exist to document the original area and extent of emergent wetlands found along the Truckee River, COE (1992) estimated that 450 acres of palustrine emergent wetlands occurred historically within 164 feet of the river downstream from Sparks. Based on FWS mapping (1995a), 31 acres occurred downstream from Sparks in the early 1990's, primarily upstream of the Tracy hydroelectric plant and upstream of Derby Diversion Dam.

Other larger examples are found downstream from Dead Ox Wash. Common plant species include cattail, hardstem bulrush, Olney's bulrush, common reed, slender-beak sedge, soft rush, least spikerush, and aquatic species, such as common waterweed and pondweed. The introduced noxious weed, tall whitetop, is also common in these wetlands.

This habitat's restricted distribution and the prevalence of plant species that require a high water table suggest it cannot tolerate long periods of drought. Streamflows of 400 to 600 cfs are usually sufficient to inundate the areas where it is found, and inundation occurs annually (FWS, 1993). Flows of 4,000 cfs or greater likely scour the channel, restricting this community to a narrow band along the banks; such flows occur about once every 3 years (FWS, 1993). See the Biological Resources Appendix for further discussion on this habitat.

4. Palustrine Scrub-Shrub Wetlands

Two types of palustrine scrub-shrub wetlands were identified in the study area: montane riparian scrub and Modoc-Great Basin riparian scrub (Holland, 1986). Palustrine scrub-shrub wetlands are dominated by shrubs or young trees less than 20 feet tall (Cowardin et al., 1979).

a. Montane Riparian Scrub

Montane riparian scrub, a deciduous shrub thicket, is found on the banks and a few gravel bars along the Truckee River upstream of Reno and along upstream tributaries. Mountain alder is the most common plant species. Other associated shrubs include yellow willow, shining willow, coyote willow, dusky willow, and American dogwood. Saplings of black cottonwood are also common. A dense canopy often precludes an extensive herbaceous understory; however, mannagrass, Kentucky bluegrass, and rusty sedge are common (Caicco, 1998; FWS, 1993).

This habitat is inundated every 1 to 5 years with flows of 100 to 6,000 cfs (FWS, 1993). Periodic inundation is needed to prepare mineral surfaces for willow seed germination. Scouring flows that reduce or remove scrub vegetation in the active channel are greater than 8,000 cfs; they occur about once every 10 years and maintain habitat diversity (FWS, 1993; Richter et al., 1996; Poff et al., 1997; Richter and Richter, 2000). The Biological Resources Appendix includes further discussion on inundation of this habitat. Adequate data are not available to determine the magnitude of flow capable of removing vegetation in tributaries to the upper Truckee River.

b. Modoc-Great Basin Riparian Scrub

The Modoc-Great Basin riparian scrub is a generally dense, deciduous thicket found downstream from Verdi along riverbanks, irrigation ditches, and on stable gravel bars (Caicco, 1998; FWS, 1993). Where willows are dominant, coyote willow is the most abundant, although yellow and shining willows are also common. Downstream from Sparks, riparian scrub habitat is often dominated by Fremont cottonwood saplings. Whether dominated by willow or cottonwood, younger stands often have dense herbaceous understories; older, denser shrub stands usually lack an herbaceous understory. The most common herbaceous species are white sweet-clover, white clover, tall whitetop, and slender-beak sedge. All but the latter are introduced species. A good example of a willow-dominated riparian scrub community occurs in Oxbow Nature Study Park in Reno.

Large areas of this habitat are uncommon in the study area, except in the backwaters of some of the higher diversion dams.

Many lower terraces and toe slopes adjacent to the river channel and on gravel bars within the active channel along the lower Truckee River are dominated by cottonwood saplings. Scour during high flows in 1986 and 1997 produced mineral surfaces that enabled abundant cottonwood seed germination in subsequent springs. Flows provided for cui-ui spawning enabled the establishment of the seedlings (Rood et al., 2003). When FWS mapped and collected field data in the early 1990s, most cottonwoods that resulted from the 1986 flood were less than 10 feet high. Such young cottonwoods are initially susceptible to loss during subsequent high flow but become less so after they have become established (Rood et at., 2003). Some unknown proportion of these cottonwood saplings are now 20-30 feet high ((Rood et al., 2003). Although these habitats now exceed the 20-foot threshold that distinguishes palustrine scrub-shrub from palustrine forest, their dense, thicket-like structure is distinctly different from more mature cottonwood forests.

Willow-dominated communities appear to be restricted to areas inundated annually, while lower terraces dominated by cottonwood saplings are inundated approximately once every 1 to 5 years; corresponding streamflows are 100 to 6,900 cfs between Reno and Nixon (FWS, 1993). As with montane riparian scrub, occasional scouring flows (greater than 10,000 cfs) are important to remove decadent vegetation and maintain the vigor and diversity of this habitat. Such flows occur about once every 10 years (FWS, 1993). The Biological Resources Appendix has further discussion on inundation of this plant community.

5. Palustrine Forested Wetlands

Palustrine forested wetlands are dominated by woody vegetation at least 20 feet tall (Cowardin et al., 1979). Three riparian forest types occur within the study area: montane black cottonwood, Modoc-Great Basin cottonwood-willow, and aspen. Montane black cottonwood forest and aspen communities are not expected to be affected by changes in reservoir operations but are discussed in the Biological Resources Appendix.

The Modoc-Great Basin cottonwood-willow riparian forest occurs at lower elevations along the Truckee River. Between Verdi and Reno, the flood plain supports a mix of species found in both montane black cottonwood and Modoc-Great Basin cottonwood-willow riparian forests (Caicco, 1998). Downstream from Reno, Fremont cottonwood is the sole dominant tree species in this deciduous forest. Coyote willow is present in the understory in some areas. More commonly, upland shrubs, including big sagebrush and rabbitbrush, are understory dominants. The prevalence of upland shrubs likely reflects a lowered groundwater table. There is little herbaceous understory, but extensive patches of tall whitetop are common. An exceptional example, with a grass understory dominated by slender wheatgrass, occurs in Oxbow Nature Study Park in Reno. More typical examples occur sporadically downstream from Sparks. Mature cottonwood trees, estimated to be up to 140 years old (FWS, 1993), are scattered infrequently on upper terraces now less subject to inundation.

The flood plain once contained more extensive cottonwood forest and scrub than exists today. From Sparks to Derby Diversion Dam, much of the flood plain had been cleared of riparian vegetation for agriculture, livestock grazing, industrial and urban or residential uses, and river channelization. An estimated 7,700 acres of riparian vegetation existed historically in the flood plain between Sparks and Pyramid Lake (COE, 1992); only 974 acres were identified in the early 1990's, an 87-percent loss in riparian vegetation (FWS, 1995a). In most areas, only remnant stands of Fremont cottonwood and willow are found.

In the early 1990's, there were about 80 acres of cottonwood-willow riparian forest between Sparks and Derby Diversion Dam, mostly in small patches (FWS, 1995a). Between Derby Diversion Dam and Marble Bluff Dam, there were an additional 336 acres of cottonwood-willow riparian forest, of which slightly more than half occurred between Wadsworth and Dead Ox Wash. Most stands were small and all were in a degraded condition due primarily to the lowered groundwater table. A more recent study found that 628 acres of riparian forest existed between Sparks and Marble Bluff in 2000 (Otis Bay Consultants, 2003, as cited in TRIT, 2003). This higher estimate is because some proportion of the cottonwood sapling dominated scrub-shrub vegetation has grown sufficiently to be classified as riparian forest.

Based on the 2000 estimate of 628 acres, there has been a 70-percent decrease in riparian forest acreage since 1939 (Otis Bay Consultants, 2003, as cited in TRIT, 2003). Jones and Stokes (1990) estimated that 108 acres of mature cottonwood were lost during the 10-year period from 1976 to 1987, which equates to less than half of the average rate of loss over the 60-year period. This suggests that a greater proportion of the forest was lost prior to 1976, likely as a result of agricultural development. The riparian corridor has also narrowed due to lower flow, channel simplification, and stream incision. In 1938, the corridor ranged from about 1,200 to 2,000 feet wide between Wadsworth and Dead Ox Wash (Jones and Stokes, 1990). It currently averages only about 230 feet wide in this reach.

6. Other Wetlands

Several small pond-like areas (in cutoff meanders and low-lying areas on the flood plain) appear to be connected hydrologically to the river (FWS, 1993). These ponds lie entirely on private lands with no public access and, therefore, the potential hydrologic connection cannot be confirmed.

B. Riparian-Associated Wildlife

As with plants, there is no comprehensive list of animals for the entire Truckee River basin. A study confined to the Lake Tahoe basin identified 312 resident or regular visitor vertebrates, a total which includes 217 birds, 59 mammals, 5 amphibians, 8 reptiles, and 23 fish species. Previous studies in the Sagehen Creek Basin, a tributary of the Little Truckee River, have documented that nearly 40 percent of the vertebrates are strongly dependent on riparian habitat (Morrison et al., 1985, as cited in Kattelmann and Embury, 1996). This figure includes all of the 6 amphibians, 5 of 12 reptiles, 17 of 54 mammals, and 46 of 120 birds, but does not include Great Basin taxa that do not occur in the upper reaches of the Truckee River.

1. Birds

Birds show a greater preference for the specific types of riparian habitats along the Truckee River than do most other types of wildlife. Among the riparian types, the greatest number of bird species is found in scrub-shrub (93 species), mature Fremont cottonwood forest (57 species), and pole-sapling Fremont cottonwood (48 species) (Lynn et al., 1998). In contrast to lower elevation riparian areas, higher elevation streams are often bordered by narrow strips of riparian vegetation within extensive coniferous forests, and so have fewer riparian-associated birds and lower numbers of bird species (Lynn et al., 1998). The high number of bird species downstream from Sparks is due to the extensive riparian scrub-shrub and Fremont cottonwood forest, both habitats that decrease in amount upstream. Higher elevation black cottonwood forests are not as diverse in bird species as the lower Fremont cottonwood riparian forests (Lynn et al., 1998). Although most species use a variety of habitats, some generalizations can be made regarding the use of emergent, scrub-shrub, and forested riparian habitats by individual species based on how often they are observed in these habitats (Lynn et al., 1998). This habitat relationship permits general inferences about the effects of flow changes on bird species numbers based on predicted changes in the habitats.

Emergent wetlands, although limited along the Truckee River and tributaries, are highly productive ecosystems that provide food, cover, and nesting sites for many species of wildlife. Areas of tall emergent vegetation, such as cattails and bulrushes, provide habitat for birds such as yellow-headed, red-winged, and Brewer's blackbirds and song sparrows. Some bird species, such as marsh wren, are restricted to tall emergent wetlands. Currently, most of the emergent wetlands are less than 1 acre and occur downstream from Sparks. As a result, emergent wetlands in the Truckee River system provide limited habitat for the above species, as well as limited foraging areas for swallows and other insectivorous birds.

Many populations of emergent wetland bird species have declined historically along the Truckee River. American bittern, sora, northern harrier, marsh wren, savannah sparrow, and common yellowthroat were common along the lower river in the late 1800s (Ridgway, 1877). None of these species was observed in the early 1970s (Klebenow and Oakleaf, 1984). During surveys in 1992 and 1993, marsh wren, savannah sparrow, and common yellowthroat were rarely observed; American bittern, sora, and northern harrier were not observed at all (Lynn et al., 1998). By 2001, however, marsh wren and common yellowthroat were common; savannah sparrow, while once again present, remained rare (Ammon, 2002a). Virginia rail, not observed since the late 1800s, was also present but rare. Neither American bittern nor sora has returned.

The palustrine scrub-shrub habitat is especially important for neotropical migratory birds. Species most frequently observed included American robin, black-billed magpie, Bewick's wren, brown-headed cowbird, Brewer's and red-winged blackbirds, song sparrow, warbling vireo, and yellow warbler (Lynn et al., 1998). A historic pattern of decline is also seen in birds associated with scrub-shrub habitats along the lower Truckee River. Black-chinned hummingbird, song sparrow, willow flycatcher, and yellow warbler were all abundant in the late 1800s, while yellow-breasted chat and rufous hummingbird were common and yellow-billed cuckoo rare (Ridgway, 1877). By the early 1970s, none of these species was observed along the lower Truckee River (Klebenow and Oakleaf, 1984). By the early 1990s, all of the species except for yellow-billed cuckoo were once again reported, although all but the song sparrow and yellow warbler were quite rare (Lynn et al., 1998). By 2001, black-chinned hummingbird and yellow-breasted chat were once also reported as common (Ammon, 2002a). Yellow-billed cuckoo and rufous hummingbird have not been observed since 1868 and the early 1970s, respectively. Small patches of riparian scrub-shrub vegetation along the Little Truckee River and Independence Creek also support high numbers of bird species, including willow flycatcher (California State Endangered Species), and yellow warbler and yellow-breasted chat (both California Species of Special Concern). They are discussed in "Endangered, Threatened, and Other Special Status Species."

Fremont cottonwood riparian forest supports the second highest diversity of bird species along the Truckee River. The most common birds in the riparian forest are American robin, black-billed magpie, brown-headed cowbird, European starling, house wren, northern oriole, and red-winged blackbird. There also appears to have been a historic decline in species that prefer cottonwood forests, particularly warbling vireo, Swainson's hawk, long-eared owl, western tanager, western bluebird, and western wood pewee. Most of these species were reported as abundant or common in 1868 (Ridgway, 1877), but were rare or not observed in the early 1970s (Klebenow and Oakleaf, 1984). By the early 1990's, warbling vireo, Swainson's hawk, and western tanager were observed along the lower Truckee River, but remained relatively rare; western bluebird was not observed (Lynn et al., 1998). More recent surveys have found western wood pewee and warbling vireo to be common; western tanager was common during surveys in 1998, but not observed in 2001 (Ammon, 2002a). Long-eared owl has not been reported from the lower Truckee River since 1868 when it was recorded as common.

The total of 107 bird species was reported from the lower Truckee River in 1868 (Ridgway, 1877), compared to 65 in the early 1970s, a decline of 40 percent. Surveys during the early 1990s reported a total of 87 species and, 10 years later, 95 bird species were observed, 89 percent of that reported in 1868 (Ammon, 2002a). While many of the recent additions are either introduced species or species associated with human settlement or agricultural landscapes that were not present in 1868 (Ammon, 2002a), more than 30 species have either increased in abundance or have reappeared after having been extirpated. More than half of these are associated either with emergent or scrub-shrub wetlands, attributed to a substantial increase in early successional riparian vegetation as a result of the implementation of supplemental streamflows designed to restore riparian vegetation beginning in the 1980s (Rood et al., 2003).

The importance of Fremont cottonwoods to birds is noteworthy. Along the lower Truckee River, nearly 40 percent of the 4,399 bird observations were in Fremont cottonwoods (Lynn et al., 1998). Willows were used about 15 percent of the time and were the only other plant species used in excess of 10 percent of the time. Plant use was distributed more evenly and across more species along the upper Truckee River: willow, 21 percent; lodgepole pine, 15 percent; Jeffrey pine, 14 percent; snowberry, 11 percent; and black cottonwood, 11 percent.

Below some threshold width, riparian habitats begin to lose species (Stauffer and Best, 1980, as cited in Dobkin and Wilcox, 1986). In 1938, the riparian corridor ranged from 1,200 to

2,000 feet wide (Jones and Stokes, 1990). In its widest sections, the riparian corridor currently is approximately 500 feet wide, but the average stand width is approximately 125 feet. The area of a riparian forest patch has also been shown to be important for some bird species. For example, in California yellow-billed cuckoo requires riparian areas larger than 12 acres and 66 feet wide to provide nesting habitat (Laymon and Halterman, 1989). The largest stand of riparian forest along the river is 13.5 acres; only about 7 percent of the stands are 5 acres or greater, and 50 percent are less than 1 acre. This may explain, in part, why yellow-billed cuckoo has not recolonized the lower Truckee River.

The small, narrow patches of riparian forest along the Truckee River, with little to no understory, may also make it easier for brown-headed cowbirds to locate and lay their eggs in the nests of other birds (obligate brood parasitism). Brown-headed cowbird brood parasitism has the potential to greatly reduce populations of the host species (Mayfield, 1977). The abundance of cowbirds has increased sharply in the past 100 years, and they are now common throughout the study area (Ridgway, 1877; Lynn et al., 1998). Ten songbird species observed along the lower Truckee River in 1992 and 1993 are frequent or common cowbird hosts (Ehrlich et al., 1988; Lynn et al., 1998). Three of these (willow flycatcher, chipping sparrow, rufous-sided towhee) appear to have declined in abundance or disappeared along the river since 1868.

Certain species require large-diameter trees for nesting and/or roosting. Along the Truckee River, sapsuckers, downy woodpeckers, and northern flickers require large cottonwoods in which they excavate their own nest cavity (primary cavity nesters). These species are important because their nest sites are subsequently used by secondary cavity nesters (occupy cavities excavated by another species). Along the lower Truckee River, native secondary cavity nesters include American kestrel, common merganser, house wren, tree swallow, violet-green swallow, and wood duck. Two introduced secondary cavity nesting species (house sparrow and European starling), which compete with native cavity nesters for nest sites, are common along the lower river. Although many of the native cavity nesters remain common today, their numbers are likely lower than they were historically. More importantly, the continuing loss of older cottonwood trees and the absence of cottonwoods in middle size classes (Caicco, unpublished data) means that species that require large-diameter trees face a habitat bottleneck within the foreseeable future.

2. Amphibians and Reptiles

Riparian areas provide habitat for amphibians and reptiles, but little is known about their habitat needs (Jennings, 1996; Reynolds et al., 1993). Open water, cool temperatures, and moist soils and microclimates make riparian areas especially important for amphibians (Brode and Bury, 1984; Jennings, 1996). Riparian areas provide breeding sites, areas of escape, and/or foraging sites for reptiles and amphibians. Thirty amphibian and reptilian species are known or are likely to occur in the various riparian habitats along the Truckee River; eight of the amphibians and six of the reptiles also occur in the Lake Tahoe basin (Schlesinger and Romsos, 2000). Ten are obligate riparian species (those found exclusively along watercourses); the others are facultative species (those that use riparian areas but are not totally dependent on them). Yosemite toad and mountain yellow-legged frog are Federal Candidate species (69 FR 24897, May 4, 2004). Northwestern pond turtle and northern leopard frog are Forest Service Sensitive Species. They are discussed further under "Endangered, Threatened, and Other Special Status Species."

Along the upper Truckee River, common species found in the river and palustrine emergent wetlands include western aquatic garter snake and Pacific treefrog (Panik, 1992). Downstream from Verdi, bullfrog is the most common species, but Pacific treefrogs are also present. Western toads appear to be limited to a few areas; however, the large numbers of tadpoles and juvenile toads present at these sites during the spring suggest a large population of adult toads. Northwestern pond turtles inhabit the Truckee River downstream from Reno in off-channel wetlands, such as permanent oxbows that have been disconnected from the river (Ammon, 2002b).

The reach between Derby Diversion Dam and Pyramid Lake contains the highest observed species diversity of amphibians in the Truckee River system because of sufficient breeding and adult habitat, including ponds for egg and larvae development and a diversity of aquatic and emergent vegetation for cover (Panik, 1992; Panik and Barrett 1994; Ammon 2002b). Bullfrogs, Pacific treefrogs, and western toads are found in this reach. Northern leopard frogs, described by Linsdale (1940) as "the commonest and most widespread kind of frog in the state," were recorded at only one field site in 1992 in a shallow spring-fed pond and along the river near Dead Ox Wash (Panik, 1992). Three locations with northern leopard frogs were identified on the Pyramid Lake Indian Reservation in 2001 (Ammon, 2002b).

In wet years, high flow may inundate areas away from the main river channel and provide temporary breeding ponds for amphibians if the water persists during egg and larvae development. In average years, the upper and middle portions of the Truckee River have few areas suitable for amphibian breeding or egg and larvae development. However, during the drought of 1992, breeding sites became more prevalent in the upper reaches of the river in major side channels with aquatic and emergent vegetation (Panik, 1992). In dry years, although breeding ponds may be prevalent, they may become desiccated before larvae complete development in late spring or summer. The relative amount of palustrine emergent wetlands and pond-like areas is indicative of potential amphibian breeding habitat along the Truckee River.

Seventeen additional species are thought to occur in the riparian scrub community. Western terrestrial garter snake, western fence lizard, and western aquatic garter snake are the most common. The abundant invertebrate population associated with the riparian scrub plant community provides an important food source for these animals.

3. Mammals

Wetland mammals known or expected to occur along the river and tributaries include muskrat, mink, water shrew, beaver, and river otter. Other mammals, including shrews, insectivorous bats, raccoons, and skunks, may forage on the abundant invertebrates associated with emergent wetlands.

Of the six mammal species that require freshwater streams and/or riparian vegetation, Sierra Nevada mountain beaver and river otter are primarily associated with palustrine scrub-shrub wetlands. Sierra Nevada mountain beaver occurs only in higher elevation riparian thickets of willow, alder, and red and white fir. Historically, river otters occurred throughout the Truckee River system; however, they are currently believed to be present only along the Truckee River near Wadsworth. Deer also use scrub-shrub wetlands along the Truckee River for cover, forage, and fawning. The Loyalton-Truckee mule deer herd winters along the Sierran front north and south of Reno and summers in higher elevation areas throughout the study area. A number of small, scattered resident mule deer herds also occur from Reno to Pyramid Lake.

The cottonwood forest along the lower and middle Truckee River provides habitat for mammals that otherwise would not be expected to occur at this elevation, including the mountain cottontail, western harvest mouse, long-tailed vole, western jumping mouse, bushy-tailed woodrat, porcupine, raccoon, long-tailed weasel, and skunk.

Cavities in cottonwood snags (dead trees) serve as den or resting sites for mammals, such as bats, spotted skunks, raccoons, martens, and weasels. Rodents, rabbits, foxes, raccoons, weasels, skunks, and otters use downed logs as hiding, feeding, and/or nesting areas. In the lower elevations of the study area, riparian forests along the Truckee River are the only sites that provide snag and log habitats. The riparian zone also provides an avenue for wildlife moving from one habitat or geographic area to another and for seasonal movements between high- and low-elevation areas.

II. Environmental Consequences

A. Introduction

Throughout the Sierra Nevada, alterations in flow from impoundments and diversions have affected riparian vegetation. Lower flows can lead to low growth rates, a loss of canopy vigor, and high mortality of riparian plants and result in narrowing of riparian corridors, and changes in the species composition and/or structure of riparian vegetation (Harris, 1986; Harris et al., 1987; Stromberg and Patten, 1991). A reduction in flood flows can lead to less frequent scour of the active channel, channel simplification, reduced rates of channel migration, and channel incision and reduced floodplain inundation; such changes lead to the encroachment of riparian vegetation into the active channel and reduced habitat diversity, respectively (Ligon et al., 1995; Kondolf et al., 1996). Three principles have emerged from research on the ecology of regulated rivers: (1) habitat diversity is substantially reduced; (2) native biodiversity decreases and non-native species proliferate; and (3) changes are generally more severe closer to dams and diversions (Stanford et al., 1996).

The rate at which riparian vegetation responds to flow reductions is highly variable. Riparian forest area declines ranging from 23 to 48 percent have been documented over a 20-year interval downstream from dams in southern Alberta (Rood and Heinze-Milne, 1989). In contrast, a study of paired reaches above and below diversions on 11 Sierra Nevadan streams diverted for 50 or more years found no difference on four streams, decreased shrub cover on two streams, decreased herbaceous cover on two streams, decreased shrub and herbaceous cover on one stream, increased herbaceous cover on one stream, and decreased tree cover on one stream; the authors attributed these results to differing environmental characteristics among stream reaches and concluded that streams in the Sierra Nevada respond individualistically to diversions (Harris et al., 1987).

Various methods have been developed to predict the effects of changes in flow on riparian vegetation (Stromberg and Patten, 1990, 1991; Stromberg, 1993; Auble et al., 1994; Stromberg et al., 1996). More recent approaches in predicting streamflow have focused on the entire riverine and riparian ecosystem (Poff et al., 1997; Richter et al., 1997). Such studies generally begin with an analysis of unimpaired regional streamflow patterns to provide a conceptual framework for evaluating the relative importance of various factors (Poff and Ward, 1987). This framework is used to assess divergence from the natural range of hydrologic variability attributable to human influences (Richter et al., 1996, 1997, 2000; Poiani et al., 2000). This allows the development of flow management strategies that, in conjunction with ecosystem monitoring, provide a scientific basis for adaptive management.

The relative amount of riparian vegetation was selected as the indicator for this resource.

B. Summary of Effects

Analysis of operations model results shows that no significant adverse effects on riparian habitat or riparian-associated wildlife species along the Truckee River or any of the affected tributaries would occur under TROA. Significant beneficial effects to both riparian habitat and riparian-associated wildlife along all reaches of the Truckee River in dry and extremely dry hydrologic conditions and along the lowermost reaches of the Truckee River in median hydrologic conditions would occur under TROA (table 3.56). Significant beneficial effects to both riparian habitat and riparian-associated wildlife also would occur along all affected tributary reaches in wet, median, dry, and extremely dry hydrologic conditions under TROA (table 3.57).

C. Relative Amounts of Riparian Habitat

1. Method of Analysis

A comparative analysis of flow characteristics from nine streams in the same climatic region as the Truckee River, all located in areas with similar geomorphologic and topographic characteristics, has shown that the magnitude, frequency, timing, and duration of flood flows in the Truckee River do not differ substantially from natural conditions (TRIT, 2003). None of the alternatives would modify the magnitude, frequency, timing, or duration of flood flows, so such flows are not addressed.

Table 3.56.—Summary of effects: riparian habitats along the mainstem of the Truckee River
(- = significant adverse effect; + = significant beneficial effect)
Summary is based on data in Biological Resources Appendix RIPARIAN tables 1-8; 14-21; and 27-34

<table>
<tr><th rowspan="2">Truckee River reach</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td colspan="6">Wet hydrologic conditions</td></tr>
<tr><td>Lake Tahoe to Donner Creek</td><td colspan="3">No effect</td><td colspan="2" rowspan="8">No effect</td></tr>
<tr><td>Donner Creek to Little Truckee River</td><td>+</td><td colspan="2" rowspan="2">No effect</td></tr>
<tr><td>Little Truckee River through Trophy</td><td>+</td></tr>
<tr><td>Mayberry</td><td>+</td><td>+</td><td>No effect</td></tr>
<tr><td>Oxbow</td><td colspan="3" rowspan="3">No effect</td></tr>
<tr><td>Spice</td></tr>
<tr><td>Lockwood</td></tr>
<tr><td>Downstream from Derby Diversion Dam</td><td>+</td><td colspan="2">No effect</td></tr>
<tr><td colspan="6">Median hydrologic conditions</td></tr>
<tr><td>Lake Tahoe to Donner Creek</td><td colspan="2">No effect</td><td>+</td><td>No effect</td><td>+</td></tr>
<tr><td>Donner Creek to Little Truckee River</td><td colspan="3">No effect</td><td colspan="2" rowspan="4">No effect</td></tr>
<tr><td>Little Truckee River through Trophy</td><td>+</td><td colspan="2">No effect</td></tr>
<tr><td>Mayberry</td><td>+</td><td>+</td><td>No effect</td></tr>
<tr><td>Oxbow</td><td colspan="3" rowspan="3">No effect</td></tr>
<tr><td>Spice</td><td>+</td><td>+</td></tr>
<tr><td>Lockwood</td><td rowspan="2">No effect</td><td>+</td></tr>
<tr><td>Downstream from Derby Diversion Dam</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td colspan="6">Dry hydrologic conditions</td></tr>
<tr><td>Lake Tahoe to Donner Creek</td><td>-</td><td>+</td><td>No effect</td><td rowspan="8">No effect</td><td>+</td></tr>
<tr><td>Donner Creek to Little Truckee River</td><td></td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River through Trophy</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Mayberry</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Oxbow</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Spice</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Lockwood</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Downstream from Derby Diversion Dam</td><td colspan="2">No effect</td><td>+</td><td>+</td></tr>
<tr><td colspan="6">Extremely dry hydrologic conditions</td></tr>
<tr><td>Lake Tahoe to Donner Creek</td><td colspan="3">No effect</td><td>+</td><td>+</td></tr>
<tr><td>Donner Creek to Little Truckee River</td><td colspan="2">No effect</td><td>+</td><td rowspan="4">No effect</td><td>+</td></tr>
<tr><td>Little Truckee River through Trophy</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Mayberry</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Oxbow</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Spice</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Lockwood</td><td>+</td><td>+</td><td>+</td><td rowspan="2">No effect</td><td>+</td></tr>
<tr><td>Downstream from Derby Diversion Dam</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
</table>

Table 3.57.—Summary of effects: riparian habitats along affected tributaries to the Truckee River
(- = significant adverse effect; + = significant beneficial effect)
Summary is based on data in Biological Resources Appendix RIPARIAN tables 9-13; 22-26; and 35-39

<table>
<tr><th rowspan="2">Tributary reach</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td colspan="6">Wet hydrologic conditions</td></tr>
<tr><td>Donner Creek</td><td colspan="2">No effect</td><td>+</td><td rowspan="5">No effect</td><td>+</td></tr>
<tr><td>Prosser Creek</td><td colspan="3" rowspan="3">No effect</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>+</td></tr>
<tr><td>Little Truckee River upstream of Stampede Reservoir</td><td>+</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td colspan="6">Median hydrologic conditions</td></tr>
<tr><td>Donner Creek</td><td>No effect</td><td rowspan="2">No effect</td><td>+</td><td rowspan="5">No effect</td><td>+</td></tr>
<tr><td>Prosser Creek</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River upstream of Stampede Reservoir</td><td colspan="3">No effect</td><td>+</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td><td colspan="2">No effect</td><td>+</td><td>+</td></tr>
<tr><td colspan="6">Dry hydrologic conditions</td></tr>
<tr><td>Donner Creek</td><td>-</td><td>-</td><td>+</td><td rowspan="5">No effect</td><td>+</td></tr>
<tr><td>Prosser Creek</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River upstream of Stampede Reservoir</td><td>No effect</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td colspan="6">Extremely dry hydrologic conditions</td></tr>
<tr><td>Donner Creek</td><td colspan="2">No effect</td><td>+</td><td rowspan="5">No effect</td><td>+</td></tr>
<tr><td>Prosser Creek</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Independence Creek</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River upstream of Stampede Reservoir</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>Little Truckee River downstream from Stampede Reservoir</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
</table>

The operations model computes average monthly flow under current conditions, No Action, LWSA, and TROA by river reach (map 3.1). Streamside vegetation also is likely to be influenced by prolonged extremes of high or low flows or by patterns of flow frequency, timing, and duration that are obscured in average monthly flows. Because average monthly flow is only one factor influencing riparian vegetation, best professional judgment was used in evaluating the effects of each alternative on riparian resources.

In lieu of more detailed data, this analysis compares average monthly flows to recommended ecosystem maintenance flows downstream from McCarran Boulevard or to recommended minimum flows (in other reaches and tributaries) from April through October. This period corresponds to the period when riparian plants emerge from winter dormancy, grow, reproduce, and re-enter dormancy, induced either by drought or colder temperatures. The ecosystem maintenance flows for the lower Truckee River incorporate flows critical to the survival of cottonwood trees in dry years (TRIT, 2003; table 3.29). Recommended flows for other reaches in Nevada and California represent minimum fish flows; it is assumed, in the absence of other data on riparian needs, that these flows also represent a critical threshold for riparian vegetation (table 3.30). The analysis focuses first on the potential adverse effects in the months when recommended flows are not met. It also evaluates the potential benefits to riparian resources when the recommended minimum flows are exceeded.

The analysis evaluates the effects of differences in flows on the maintenance of riparian habitats and, by extension, to riparian-associated wildlife. Habitat and, in particular, habitat structure, as a surrogate measure in predictive modeling of wildlife status, while not without limitations, is widely accepted especially where detailed information about the distribution and status of animals is limited (Schroeder and Allen, 1992; Morrison et al., 1998; Roloff et al., 2001).

2. Threshold of Significance

Operation models results show that there are relatively few months in which average monthly flow in any given reach differs by more than 15 percent among current conditions and the alternatives. At a 10-percent difference in flows, however, distinct patterns emerge. Therefore, an effect was identified as significantly adverse whenever the average monthly flow was 10 percent or more lower than the flow to which it was compared in any month when either recommended minimum flows (reaches 1-12; map 3.1) or recommended ecosystem flows (reaches 13 and 14; map 3.1) were not met from April through October. An effect was identified as significantly beneficial whenever the average monthly flow was 10 percent or more higher than the flow to which it was compared in any month, regardless of whether the recommended minimum or ecosystem flow was met or not. Significance (adverse or beneficial) was based on best professional judgment and considered the timing and duration of the higher or lower flow (i.e., when it occurred during the growing season and for how many months it extended) as well as the flow in the month or months that preceded and followed.

3. Model Results

a. Truckee River Reaches

Operations model results show that recommended minimum flows between Lake Tahoe and Donner Creek generally are not met under current conditions or any alternative from August through October in dry hydrologic conditions, and from July though October in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 1). Minimum flows are always met in wet and median hydrologic conditions.

From Donner Creek through the Trophy reach, recommended minimum flows generally are not met in September and October in extremely dry hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 2 and 3). From the Mayberry reach through the Spice reach, recommended minimum flows generally are not met from August through October in extremely dry hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 4-6).

Downstream from Sparks, recommended ecosystem flows for the Truckee River are not met under current conditions or any alternative in June and July in wet hydrologic conditions and in all months in dry or extremely dry hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 7 and 8).

b. Upper Tributary Reaches

In Donner Creek, the recommended minimum flow is not met in August in wet hydrologic conditions and in July and August in median hydrologic conditions under current conditions or the alternatives. In dry and extremely dry hydrologic conditions, the recommended minimum flow is not met from May through October (Biological Resources Appendix, table RIPARIAN 9).

In Prosser Creek, the recommended minimum flow is not met under current conditions or the alternatives in August and September in median hydrologic conditions. In dry and extremely dry hydrologic conditions, the recommended minimum flow is not met under current conditions or the alternatives in April and from July through October; the recommended minimum flow also is not met under No Action or LWSA in June in extremely dry conditions (Biological Resources Appendix, table RIPARIAN 10).

Independence Lake releases do not meet the recommended minimum flow for Independence Creek under No Action and LWSA in August in median hydrologic conditions. In dry hydrologic conditions, the recommended minimum flow is not met under No Action, LWSA, or TROA in April; and under current conditions, No Action, and LWSA from June through September. In extremely dry hydrologic conditions, the recommended flow is not met under current conditions, No Action, and LWSA from April through September. The recommended minimum flow for Independence Creek is not met under TROA in July in dry hydrologic conditions and in July and August in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 11).

In the Little Truckee River upstream of Stampede Reservoir, operations model results show the recommended minimum flow is not met under No Action and LWSA in August or under current conditions or any alternative in October in median hydrologic conditions. In addition, the recommended minimum flow is not met from July through October in dry hydrologic conditions, or from June through October in extremely dry hydrologic conditions under current conditions or any alternative (Biological Resources Appendix, table RIPARIAN 12).

Downstream from Stampede Reservoir, the recommended minimum flow in the Little Truckee River is not met under current conditions or any alternative in September and October in median hydrologic conditions. In dry hydrologic conditions, the recommended minimum is not met under current conditions or any alternative in June and from August through October. The recommended minimum flow also is not met in extremely dry hydrologic conditions under current conditions or any alternative from May through October (Biological Resources Appendix, table RIPARIAN 13).

4. Evaluation of Effects

a. No Action

i. Truckee River Reaches

Operations model results show that in the months when the recommended minimum flow between Lake Tahoe and Donner Creek is not met, flows are about 20 percent lower under No Action than under current conditions in September in dry and extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 14). When plants are already stressed, this situation is likely to cause many riparian plants to shed their leaves and enter dormancy early. While most riparian plants are likely to survive such an event and re-emerge the next spring, they are likely to be less vigorous because they will not have had sufficient time to store energy prior to entering dormancy. Consecutive years of dry or extremely dry hydrologic conditions are likely to cause the death of individual plants, leading to change in riparian community structure, process, and function. This would typically be a shift in dominance from riparian shrubs either to emergent herbaceous plants or, during extended droughts, to herbaceous plants adapted to upland conditions. The latter condition, a narrowing of the riparian zone, would be a significant adverse effect. While flow is 10 percent or more higher under No Action than under current conditions in October in dry and extremely dry hydrologic conditions, riparian plants are unlikely to recover from the adverse effects of the previous month's low flows.

From Donner Creek through the Spice reach, flows are 10 percent or more lower under No Action than under current conditions in the months when the recommended minimum flow is not met only in September in extremely dry hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 15-19). Although this is a potential adverse effect, it likely would be offset by substantially higher flows in preceding months, which should increase the available water in the soil matrix. Significant beneficial flow increases under No Action when compared to current conditions also occur in most reaches between July and

September in dry hydrologic conditions, and in several reaches in October in wet or median hydrologic conditions.

Flows in the Lockwood reach are 10 percent or more lower under No Action than under current conditions in April and May in dry hydrologic conditions and in April in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 20). Although higher flows are required for cottonwood recruitment in April and May, flows in this reach are always inadequate for seed germination in dry and extremely dry hydrologic conditions. Therefore, this potential adverse effect likely would be offset by substantially higher flows later in the summer. Flows downstream from Derby Diversion Dam are more than 40 percent lower under No Action than under current conditions in September in extremely dry hydrologic conditions, but any adverse effects of these low flows likely would be offset by substantially higher flows in all preceding months (Biological Resources Appendix, table RIPARIAN 21).

ii. Tributary Reaches

In Donner Creek, flows under No Action and current conditions differ by 10 percent or more only in September and October in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 22). The 25-percent lower flows in September likely would cause some riparian shrubs to shed their leaves and enter dormancy, which would be a significant adverse effect. Higher flows in October would be unlikely to compensate for this adverse effect. Several successive years in dry hydrologic conditions could lead to a loss of vigor in individual shrubs and a decrease in the total extent of riparian shrub vegetation, leading to change in riparian community structure, process, and function.

In Prosser Creek, flows are 35-50 percent lower under No Action than under current conditions in the months when the recommended minimum flow is not met in July in dry and extremely dry conditions (Biological Resources Appendix, table RIPARIAN 23). These lower flows in the middle of the growing season would be likely to inhibit the growth and reproduction of riparian plants, especially those growing at the edge of the riparian zone. Consecutive years of dry or extremely dry hydrologic conditions could lead to a substantial narrowing of the riparian corridor, which would be a significant adverse effect. Flows are greater under No Action than under current conditions in October in median hydrologic conditions and would provide a significant beneficial effect by extending the growing season of riparian plants. Higher flows in October in dry hydrologic conditions and in May in extremely dry hydrologic conditions would be unlikely to compensate for the lower flows in July that occur under such conditions.

In Independence Creek, in the months when the recommended minimum flow is not met, flows are 10 percent or more lower under No Action than under current conditions in August in median hydrologic conditions, in June in dry hydrologic conditions, and from April through June in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 24). These lower flows in the early and middle parts of the growing season would be unlikely to be offset by higher flows that occur in October in these hydrologic conditions and, therefore, are all significant adverse effects.

In the Little Truckee River upstream of Stampede Reservoir, in the months when the recommended minimum flow is not met, flows are 10 percent or more lower under No Action than under current conditions only in July in dry and extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 25). Although this is potentially significant, flows are only 1 cfs lower, and no significant adverse effect is expected. Flows that are 10 percent or more higher under No Action than under current conditions occur in September and October in extremely dry hydrologic conditions and would be likely to provide a significant beneficial effect by extending the growing season or supplying additional water during the growing season for riparian shrubs and trees in this reach.

Operations model results show that flows under No Action in the Little Truckee River downstream from Stampede Reservoir would not result in a significant adverse effect when compared to current conditions in any hydrologic condition (Biological Resources Appendix, table RIPARIAN 26). Flows are 10 percent or more higher under No Action than under current conditions in October in wet hydrologic conditions and in July in dry and extremely dry hydrologic conditions. By extending the growing season or supplying additional water during the growing season, especially in dry and extremely dry hydrologic conditions, these higher flows would provide a significant beneficial effect.

b. LWSA

i. Truckee River Reaches

In the Truckee River between Lake Tahoe and Donner Creek, flows are the same under LWSA and No Action, except in October in extremely dry hydrologic conditions, when they are 10 percent or more higher (Biological Resources Appendix, table RIPARIAN 27). These higher flows would provide a significant beneficial effect by extending the growing season for riparian shrub and forest vegetation. In the months when the recommended minimum flow is not met, flows are 10 percent or more lower under LWSA than under current conditions in September in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 15). This potential adverse effect likely would be offset by higher flows in August and October.

In the Spice reach, flows differ 10 percent or more between LWSA and No Action only in October in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 32). This would be a significant beneficial effect under LWSA. From Donner Creek through the Spice reach, flows are 10 percent or more lower under LWSA than under current conditions in the months when the recommended minimum flow is not met only in September in dry hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 15-19). This potentially adverse effect would be offset by substantially higher flows in preceding months and in October in such conditions. In all but reach 7, higher flows in preceding months would result in a significant beneficial effect when compared to current conditions. A significant beneficial effect would occur under LWSA when compared to current conditions in most reaches from July through September in dry hydrologic conditions, and in several reaches in October in wet or median hydrologic conditions (Biological Resources Appendix, tables RIPARIAN 15-19).

Flows in the Lockwood reach do not differ by 10 percent or more between LWSA and No Action. Flows are 10 percent or more lower under LWSA than under current conditions in April and May in dry hydrologic conditions and in April in extremely dry hydrologic conditions. The effect would not be adverse because flows adequate for cottonwood regeneration do not occur in dry and extremely dry hydrologic conditions and because of substantially higher flows in subsequent months (Biological Resources Appendix, table RIPARIAN 20). Flows in this reach also are 10 percent or more higher under LWSA than under current conditions in August and September in median hydrologic conditions. These higher flows would result in a significant beneficial effect.

Flows downstream from Derby Diversion Dam do not differ by 10 percent or more between LWSA and No Action (Biological Resources Appendix, table RIPARIAN 34). Flows are nearly 40 percent lower under LWSA than under current conditions in September in extremely dry hydrologic conditions, but any adverse effects would be offset by substantially higher flows in all preceding months (Biological Resources Appendix, table RIPARIAN 21).

ii. Tributary Reaches

In Donner Creek, flows are 10 percent or more higher under LWSA than under No Action only in October in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 35). The small difference would be unlikely to provide much benefit this late in the growing season. Flows differ by 10 percent or more from those under current conditions only in September in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 22). The 25-percent lower flows would be a significant adverse effect; some riparian shrubs would likely shed their leaves and enter dormancy early under such conditions. Higher flows in October would be unlikely to compensate for this adverse effect because these plants are unlikely to re-emerge from dormancy this late in the growing season. Several successive years of dry hydrologic conditions could lead to a loss of vigor and death of individual shrubs and a decrease in the total extent of riparian shrub vegetation.

Flows in Prosser Creek do not differ by 10 percent or more between LWSA and No Action (Biological Resources Appendix, table RIPARIAN 36). Flows are 10 percent or more lower under LWSA than under current conditions in the months when the recommended minimum flow is not met in July in dry and extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 23). This would be a significant adverse effect. Flows in October in median and dry hydrologic conditions and in May in extremely dry hydrologic conditions are higher under LWSA than under current conditions. The higher October flows would be unlikely to provide much benefit to riparian vegetation because they would occur too late in the growing season. Any benefits of higher May flows in extremely dry hydrologic conditions likely would be offset by the lower July flows.

Flows in Independence Creek do not differ by 10 percent or more between LWSA and No Action (Biological Resources Appendix, table RIPARIAN 37). In the months when recommended minimum flows are not met, flows are 10 percent or more lower under LWSA than under current conditions in August in median hydrologic conditions, in April and June in dry hydrologic conditions, and from April through June in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 24). Successive years of dry or extremely dry hydrologic conditions are likely to lead to the death of individual riparian shrubs, perennial herbs, and grasses and also to a significant narrowing of the riparian corridor. This would be a significant adverse effect.

Flows in the Little Truckee River upstream of Stampede Reservoir do no differ by 10 percent or more between LWSA and No Action (Biological Resources Appendix, table RIPARIAN 38). In the months when the recommended minimum flow is not met, flows are 10 percent or more lower under LWSA than under current conditions only in July in dry and extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 25). Although this is a potential adverse effect, flows are only 1 cfs lower and no significant adverse effect is expected. Flows are 10 percent or more higher under LWSA than under current conditions only in September and October in extremely dry hydrologic conditions. These flows would be likely to provide a significant beneficial effect by extending the growing season for riparian vegetation in this reach.

Flows in the Little Truckee River downstream from Stampede Reservoir do not differ by 10 percent or more between LWSA and No Action (Biological Resources Appendix, table RIPARIAN 38). Flows are never 10 percent or more lower under LWSA than under current conditions in any hydrologic condition (Biological Resources Appendix, table RIPARIAN 26). Flows are 10 percent or more higher under LWSA than under current conditions in October in wet hydrologic conditions and in July in dry and extremely dry hydrologic conditions. These higher flows would be a significant beneficial effect.

c. TROA

i. Truckee River Reaches

Operations model results show that in the Truckee River between Lake Tahoe and Donner Creek, flows are 10 percent or more lower under TROA than under No Action only in September in dry hydrologic conditions, a potentially adverse effect that would be offset by substantially higher flows from May through June (Biological Resources Appendix, table RIPARIAN 27). Flows are 10 percent or more higher under TROA than under No Action in July in median hydrologic conditions and in October in dry and extremely dry hydrologic conditions. In the months when the recommended minimum flow is not met, flows are 10 percent or more lower under TROA than under current conditions in September in dry hydrologic conditions and in August and September in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 14). Potentially adverse effects would be likely in dry hydrologic conditions in most other months and in October in extremely dry hydrologic conditions.

In the Truckee River from Donner Creek through the Spice reach, flows in the Truckee River are never 10 percent or more lower under TROA than under No Action (Biological Resources Appendix, tables RIPARIAN 28-32). Flows are 10 percent or more higher under TROA than under No Action in September and October in dry hydrologic conditions in most reaches. In extremely dry hydrologic conditions, flows are 10 percent or more higher under TROA than under No Action from August though October from the confluence of the Little Truckee River through the Mayberry reach, and from June through October in the Oxbow and Spice reaches. These would be significant beneficial effects that would enhance the vigor of riparian shrub and forest vegetation. Flows are never 10 percent or more lower under TROA than under current conditions during months when the recommended minimum flow is not met (Biological Resources Appendix, tables RIPARIAN 15-19). Significant beneficial effects would occur in all reaches when TROA is compared to current conditions, especially in dry and extremely dry hydrologic conditions. These higher flows occur only from August through October in the uppermost reach, but occur from July though October in dry hydrologic conditions and from June through October in extremely dry conditions from the Mayberry reach through the Spice reach. These higher flows would enhance the vigor of riparian vegetation, which would be a significant beneficial effect.

In the Lockwood reach, flows are never 10 percent or more lower under TROA than under No Action, but they are 10 percent or more higher from June through October in dry hydrologic conditions and from June through October in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 33). These higher flows would enhance the vigor of riparian shrub and forest vegetation along the lower Truckee River and would be a significant beneficial effect. Flows are 10 percent or more lower under TROA than under current conditions in May in dry hydrologic conditions and in April in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 20). The potentially adverse effects of these low spring flows would be offset by substantially higher flows from August through October in dry hydrologic conditions and from June through October in extremely dry hydrologic conditions because TROA would allow the release of water to be withheld in the spring in order to create Credit Water that could then be released later in the year or in a subsequent year to enhance flow during low-flow periods.

Downstream from Derby Diversion Dam, flows are 10 percent or more higher under TROA than under No Action in April and June in median hydrologic conditions (Biological Resources Appendix, table RIPARIAN 34). This would be a significant beneficial effect and reflects the intent of TROA to make more water available for cottonwood regeneration when sufficient water is available. Flows also are 10 percent or more higher under TROA than under No Action in August in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 34). In extremely dry hydrologic conditions, flows are 10 percent or more higher under TROA than under No Action in April and from July through October. These higher flows would enhance the maintenance of riparian shrub and forest vegetation and would be a significant beneficial effect. Flows are 10 percent or more higher under TROA than under current conditions in July in wet hydrologic conditions; in June, August, and September in median hydrologic conditions; in August in dry hydrologic conditions; and in all months in extremely dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 21). These higher flows would result in significant beneficial effects.

ii. Tributary Reaches

In Donner Creek, flows differ by 10 percent or more between TROA and current conditions only in May in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 22). This potentially adverse effect would be offset by substantially higher flows from June through October. Flows also are higher under TROA than under current conditions in August in wet hydrologic conditions, in July and August in median hydrologic conditions, and from June through October in extremely dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation and would be a significant beneficial effect. Operations model results show the same pattern of significant beneficial flows when TROA is compared to No Action (Biological Resources Appendix, table RIPARIAN 36).

In Prosser Creek, flows are never 10 percent or more lower under TROA than under No Action. Flows are never 10 percent or more lower under TROA than under current conditions during months when the recommended minimum flow is not met (Biological Resources Appendix, table RIPARIAN 23). Flows are higher under TROA than under current conditions in September in wet hydrologic conditions, in August and September of median hydrologic conditions, from April and June though October in dry hydrologic conditions, and in May and July though October in extremely dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation.

In Independence Creek, in the months when the recommended minimum flow is not met, flows are 10 percent or more lower under TROA than under current conditions only in April in dry hydrologic conditions (Biological Resources Appendix, table RIPARIAN 24). This potentially adverse effect would be offset by substantially higher flows from June though September. Flows also are higher under TROA than under current conditions in October in wet hydrologic conditions, in August and October in median hydrologic conditions, and in April and from July though October in extremely dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation and would be a significant beneficial effect. Operations model results show the same pattern of beneficial flows when TROA is compared to No Action, although in most months, flows are considerably higher (Biological Resources Appendix, table RIPARIAN 37).

Flows in the Little Truckee River upstream of Stampede Reservoir are never 10 percent or more lower under TROA than under current conditions (Biological Resources Appendix, table RIPARIAN 25). Flows are higher under TROA than under current conditions in October in wet hydrologic conditions; in July and August in median hydrologic conditions; from June though September in dry hydrologic conditions; and in April and from July though October in extremely dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation and would be a significant beneficial effect. Operations model results show the same general pattern of significant beneficial flows when TROA is compared to No Action (RESOURCES APPENDIX, table RIPARIAN 38).

Downstream from Stampede Reservoir, flows in the Little Truckee River are higher under TROA than under No Action in September in wet hydrologic conditions; from August though October in median hydrologic conditions; and in all months except July in dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation and would be a significant beneficial effect. Flows are 10 percent or more lower under TROA than under No Action only in July in extremely dry hydrologic conditions. This potentially adverse effect would be offset higher flows in all other months under such conditions.

Flows are never 10 percent or more lower under TROA than under current conditions (Biological Resources Appendix, table RIPARIAN 26). Flows are higher in September and

October in wet and median hydrologic conditions, in May, June, and August through October in dry hydrologic conditions, and from May though October in extremely dry hydrologic conditions. These higher flows would enhance the vigor of riparian vegetation and would be a significant beneficial effect.

5. Mitigation and Enhancement

No mitigation would be required because of the benefits and enhanced environmental conditions that would occur under TROA. Riparian habitat for riparian-associated wildlife species would be enhanced under TROA.

ENDANGERED, THREATENED, AND OTHER SPECIAL STATUS SPECIES

Modifying operations of Truckee River reservoirs could affect elevations of lakes and reservoirs and the quality, quantity, timing, and duration of flow in the Truckee River and its tributaries. These changes could affect the life histories, habitat, and potential for recovery of endangered, threatened, and other special status species.

Lake and reservoir elevations, as well as flow, influence fish access to streams for spawning, thereby affecting their ability to reproduce, which may, in turn, affect the aquatic prey base for birds that forage on fish. The reproductive success of birds nesting on islands may be reduced if a landbridge forms as a result of low elevations in certain reservoirs. Changes in the elevation of Lake Tahoe could affect the acres of beach habitat available for Tahoe yellow cress, thereby affecting populations of this plant. Acres of riparian habitat used by special status species along streams also may change over time with changes in flow.

Forty-three special status species that could be affected by the alternatives occur or potentially occur in the study area. Federal endangered, threatened, and candidate species that could be affected and their distributions are listed in table 3.58. An “endangered species” is defined as a species in danger of extinction throughout all or a significant portion of its range. A “threatened species” is defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. If a federally listed species may be affected by the proposed action, consultation with FWS under section 7(c) of ESA will be completed. Also shown in table 3.59 are species listed by the States of California and Nevada as endangered or threatened.

Other Federal and State special status species also could be affected (table 3.57). CDFG's “Species of Special Concern” designation applies to species that are not already included on Federal or California endangered, rare, or threatened lists, but are declining or are so few in number in California that extirpation is a possibility. Species on this list have no legal status under California State law.

FWS Birds of Conservation Concern include “species, subspecies, and populations of migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under ESA. Forest Service (USFS) “sensitive species” are recognized as needing special management to prevent them from becoming endangered or threatened (Bergen and Barker, 1990). The Nevada Natural Heritage Program and the California Native Plant Society maintain prioritized lists of sensitive plants and animals and plants, respectively. Candidate species are those for which FWS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species, but for which development of a listing regulation is precluded by other higher priority listing activities. The general distribution and habitat of all such sensitive along the Truckee River and associated lakes and reservoirs potentially affected by changes in reservoir management are presented in table 3.58. Eighty-eight special status species known or likely to occur in the study area would not be affected by any alternative and are summarized in the Biological Resources Appendix.

Table 3.58.—Federal and State endangered, threatened, and candidate species occurring or having the potential to occur in the study area that could be affected by modifying reservoir operations

Species	Status[1]	Habitat	Distribution
Plants			
Tahoe yellow cress	C; FSS CE; NE	Beaches and margins of drainages that flow across beaches; sandy or cobbly substrates with little soil formation and good drainage	Endemic to Lake Tahoe Basin, with exception of historic record from Truckee, California
Fishes			
Cui-ui	E; NE	Freshwater lake and inflow	Only population is in Pyramid Lake; spawns in lower Truckee River
Lahontan cutthroat trout	T	Coldwater rivers, streams, and lakes	Lahontan Basin in northern Nevada, eastern California, and southern Oregon; Pyramid Lake, Truckee River, and Independence Lake
Birds			
Swainson's hawk	BCC; CT	Associated western grasslands; nests predominantly in cottonwoods and elms in agricultural valleys	Documented nesting near Truckee River; possible breeding in the Lahontan Valley
Bald eagle	T; CE; NE	Nests and roosts in trees near lakes, reservoirs, and rivers	Nests in upper Truckee River basin, at Lake Tahoe, and at Lahontan Reservoir; winters throughout study area; fall concentrations at Taylor Creek and Little Truckee River during kokanee spawning
Willow flycatcher	FSS; CE	Nests in riparian areas with broad, flat meadows containing dense willows	Historic records along lower Truckee River; recent records along Little Truckee River, upper Truckee River, and vicinity of Independence Lake; Little Truckee River supports the second largest population in California
Mammals			
Spotted bat	CSSC; NT	Deserts to high mountains; roosts primarily in crevices in cliffs near water; may forage in riparian areas	Western States, including California and Nevada; documented in seven counties in Nevada; three specimens from Reno, Washoe County.

[1] Status: Federal E = endangered; T = threatened; C = Candidate; BCC = FWS Bird of Conservation Concern; FSS = Forest Service sensitive species.
State NE = Nevada endangered; NT = Nevada Threatened; CE = California Endangered; CT = California Threatened; CSSC = California Department of Fish and Game Species of Special Concern

Table 3.59.—Federal and State special status species occurring or having the potential to occur in the study area that could be affected by modifying operations of Truckee River reservoirs

Species	Status1	Habitat	Distribution
Plants			
Shore sedge (*Carex limosa*)	CNPS 2	Lake and pond lake margins, bogs and fens, and along low gradient streams often growing in sedge or sphagnum peat; elevation range 3936 - 8856 feet	Nevada and El Dorado Counties, CA; vicinity of Sagehen Creek and Grass Lake
Grants Pass willowherb (*Epilobium oreganum*)	FSS; CNPS 1B	Small streams, ditches, and bogs in lower montane coniferous forests; elevation range 1640 - 7350 feet	Nevada, Placer, and El Dorado Counties, CA; vicinity of Sagehen Creek and Echo Summit
American manna grass (*Glyceria grandis*)	CNPS 2	Wet places, meadows, lake and stream margins; elevation range 50 - 6495 feet	Placer Co.; vicinity of Squaw Creek and Truckee River
Marsh skullcap (*Scutellaria galericulata*)	CNPS 2	Wet sites, meadows, streambanks, coniferous forest; elevation range 0 - 6888 feet	Nevada, El Dorado, and Placer Counties, CA; vicinity of Truckee River
Plumas ivesia (*Ivesia sericoluca*)	CNPS 1B	Meadows, rocky streams, and vernal pools within sagebrush and upper montane forest; elevation 4600 - 6600 feet	Vicinity of Stampede Reservoir, Prosser Creek Reservoir, Little Truckee River, and Truckee River
Slender-leaved pondweed (*Potamogeton filiformis*)	CNPS 2	Shallow, clear water of lakes and drainage channels; elevation range 984 - 7052 feet	Placer Co., CA; historic record from Lake Tahoe
White-stemmed pondweed (*Potamogeton praelongus*)	CNPS 2	Deep water, lakes; elevation range 5900 - 9840 feet	Sierra County, CA
Water bulrush (*Scirpus subterminalis*)	CNPS 2	Lakes, ponds, and marshes; elevation range 2460 - 7380 feet	Nevada and El Dorado Counties, CA; vicinity of Grass and Upper Angora Lakes
Veined water lichen (*Hydrothyria venosa*)	FSS	Clear, flowing, mid- to high-elevation streams where water quality appears to be very good	Known from Calaveras to Tulare Counties, CA
Three-ranked hump-moss (*Meesia triquetra*)	FSS; CNPS 2	Meadows and seeps, damp soil within upper montane coniferous forest; elevation range 4264 - 8200 feet	Nevada and El Dorado Counties, CA
Broad-nerved hump-moss (*Meesia uliginosa*)	FSS	Meadows and seeps, bogs and fens, upper montane coniferous forest; elevation range 4264 - 8200 feet	Nevada County, CA

Table 3.59.—Federal and State special status species occurring or having the potential to occur in the study area that could be affected by modifying operations of Truckee River reservoirs—continued

Species	Status1	Habitat	Distribution
Invertebrates			
California floater (*Anodonta californiensis*)	NNHP S1?	Water less than 6.5 feet deep in lakes and rivers; usually slow moving water; adults in sand, mud, or stream bottom	Historic record in Truckee River, late 1800s
Great Basin rams-horn (*Helisoma newberryi newberryi*)	FSS	Large spring complexes	Reported from Lake Tahoe and adjacent downstream slow-flowing segment of the Truckee River
Nevada viceroy (*Limenitus archippus lahontani*)	NNHP S1S2	Riparian habitats with willows, its host plant	Apparently restricted to Nevada where known from the Humboldt River and near Fallon and Fernley
Aquatic moth (*Petrophila confusalis)*	NNHP S1	Well-oxygenated water of streams and lakes	Known to occur in Pyramid Lake.
Fishes			
Mountain sucker	CSSC	Small, clear mountain streams with rubble, sand, or boulder bottoms; occasionally lakes or reservoirs	Sagehen Creek, Little Truckee River, Prosser Creek, Martis Creek, and Truckee River
Amphibians			
Northern leopard frog	FSS	Brackish and freshwater marshes with dense vegetation; desert lowlands to high mountain meadows	Lower reach of Truckee River; 8.0 to 12.0 miles upstream from Pyramid Lake
Reptiles			
Northwestern pond turtle (*Clemmys marmorata*)	FSS	Inhabits permanent and intermittent aquatic habitat. Hatchlings prefer water less than 1 foot deep with emergent vegetation	Suitable habitat has been identified in three areas along the Truckee River (Holland, 1991)
Birds			
Northern Harrier	CSSC	Uses wetlands, meadows, and agricultural areas	Year-round resident in Nevada; probable breeding near Truckee River; lower Truckee River
American white pelican	NNHP S2, CSSC	Islands in freshwater lakes used for breeding; forages in rivers, lakes, and marshes	Anaho Island supports one of largest breeding colonies in US; forages in Pyramid Lake, Humboldt Sink, Honey Lake, Stillwater Marshes, Carson Lake, and Truckee River; winters on California coast and Central Valley
Long-billed curlew	FSS BCC/CSSC	Nests in emergent wetlands, meadows, and pastures	Summer resident in Nevada; occasional sightings on lower Truckee River
California gull	CSSC	Nests colonially on islands; forages in a variety of habitats	Nests colonially on Ahaho Island and the island in Lahontan Reservoir; winters on west coast

Table 3.59.—Federal and State special status species occurring or having the potential to occur in the study area that could be affected by modifying operations of Truckee River reservoirs—continued

Species	Status1	Habitat	Distribution
Birds (continued)			
Osprey	CSSC, NNHP S2	Nests in snags near lakes or rivers with abundant fish	Nests at Lake Tahoe and Stampede Reservoir; formerly nested at Lahontan and S-Line Reservoirs; observed throughout Nevada during spring and fall migrations
Yellow warbler	CSSC	Nests in riparian thickets (especially willow) and riparian forest with dense understories	Along Truckee River and tributaries
Yellow-breasted chat	CSSC	Nests in dense riparian thickets in valleys	Historically common along lower Truckee River, but now rare; possible breeding near Truckee River
Mammals			
Pale Townsend's big-eared bat (*Corynorhinus townsendii*)	FSS/CSSC	Roosts in caves and mines in a variety of habitats; may forage in riparian areas	Historic records near Pyramid Lake, Stillwater, and Fallon
Fringed myotis (*Myotis thysanodes*)	NNHP S2	From low desert to fir-pine forests	Throughout study area
Pallid bat (*Antrozous pallidus*)	FSS/CSSC	Primarily open lowland habitats below 6600 feet; roosts in caves, tunnels, and hollow trees; feed almost entirely on the ground.	Nevada portion of study area
Western red bat (*Lasiurus blossevillii*)	FSS	Found primarily in wooded habitats including cottonwood/willow riparian areas	Rare in Nevada; documented in four Nevada counties including southern Washoe and eastern Churchill Counties.

[1] Status: Federal: BCC = FWS Bird of Conservation Concern; FSS = Forest Service sensitive species
State: CSSC = California Department of Fish and Game Species of Special Concern; CNPS = California Native Plant Society (1B = Rare or endangered in California and elsewhere; 2 = Rare and endangered in California, more common elsewhere); NNHP = Nevada Natural Heritage Program (S1 = Critically imperiled in Nevada due to extreme rarity, imminent threats, and/or biological factors; S2 = Imperiled in Nevada due to rarity and/or other demonstrable factors).

CUI-UI

I. AFFECTED ENVIRONMENT

A. Status and Distribution

Cui-ui, *Chasmistes cujus*, were abundant in Pyramid Lake and in the adjacent Winnemucca Lake at the beginning of the 20th century. As water diversions for M&I and agricultural uses, especially the Newlands Project, were developed, Truckee River inflow to Pyramid Lake diminished substantially. During the 1930s, the elevation of Pyramid Lake dropped rapidly and a large delta formed at the mouth of the Truckee River, making it frequently impassable to the stream spawning cui-ui. Winnemucca Lake dried up at this time as well. By the early 1940s, the Pyramid Lake strain of LCT had been extirpated. In most years after the 1930s, neither cui-ui nor LCT were able to gain access to the river for spawning. By 1967, Pyramid Lake was nearly 80 feet lower than in 1900. FWS and the State of Nevada listed the cui-ui as endangered in 1967. A Recovery Plan was approved in 1978, with the most recent revision completed in 1992.

Because cui-ui may live as long as 45 years or more (Scoppetonne et al., 1996), it has been able to take advantage of the occasional high water years to reproduce. From 1950 to 1979, cui-ui produced large numbers of young in only two years (1950 and 1969) (Scoppettone and Vinyard, 1991). Successful spawning occurred in 14 years from 1980 to 2003. This improvement is attributed to cooperative management efforts among FWS, BOR, and the Pyramid Tribe; construction of Marble Bluff Dam and subsequent design improvements; the dedication of Stampede Reservoir storage to cui-ui and LCT; wet years and flow management during drought years that support spawning under less flow; and, reduced diversions to the Newlands Project over the last two decades. Recent cui-ui adult passage through Marble Bluff Dam is summarized below for the most recent 10-year period:

Year	Estimated spawners	Year	Estimated spawners
1994	66,000	1999	584,000
1995	113,000	2000	183,000
1996	192,000	2001	No spawning run
1997	307,000	2002	40,000
1998	500,000	2003	159,000

B. Life History

The lake-dwelling cui-ui is an obligatory stream spawner in the Truckee River. The size of the spawning run is influenced by the size and year-class structure of the adult population, river access, and inflow. When lake elevation and spring inflows have been high, spawning runs have been large (Buchanan and Coleman, 1987). The spawning migration begins in April or May, depending on inflow, river access and water temperatures and continues for 4 to 8 weeks. Most of the spawners enter the river during a 1- to 2-week period (Buchanan and Coleman, 1987).

Historically, cui-ui may have spawned in the lower 43 miles of the Truckee River. Most now spawn downstream from Numana Dam, but cui-ui migrate beyond Numana Dam during high spawning runs. An estimated 250,000 have been observed at Wadsworth and larvae have been captured just downstream from Wadsworth. (Heki, 2004). Cui-ui spend up to 16 days in the river: 1 to 11 days acclimating to the river environment before spawning and 1 to 5 days after spawning is initiated. Once an adult has finished spawning, it moves back to the lake within hours and does not return to the river until the following spring at the earliest (Scoppettone et al., 1986).

Like other suckers, cui-ui spawn in groups, depositing eggs over a broad area of predominantly gravel substrate in water 0.8 to 4.0 feet deep, where water velocity is 1 to 2 feet per second (Buchanan and Coleman, 1987). Fertilized eggs hatch in 1 to 2 weeks depending on water temperature. Embryo survival decreases when daily maximum temperatures exceed 63 ºF. After eggs hatch, the yolk-sac larvae spend 5 to 10 days in the gravel before they emerge. Cui-ui are considered yolk-sac larvae from the time they hatch until the yolk-sac is absorbed and feeding begins, about two weeks. Upon emergence, most larvae are swept passively downstream to the lake, although a few may find refuge in the river's backwaters for a month or two. The mouths of larvae do not open until about 16 days after hatching (Bres, 1978), and emigrating larvae usually retain their yolk sacs. The timing of mouth opening corresponds with entry into the lake.

Upon reaching the lake, larvae remain in the shallow littoral zone feeding on zooplankton. In late summer they disperse into deeper water, where both young-of-the-year juveniles and adults feed on zooplankton and benthic invertebrates. Although juveniles and adults are commonly found near the lake bottom in 50 to 100 feet of water throughout the year, their movement in Pyramid Lake is not well known (Buchanan and Coleman, 1987).

C. Management

1. Flow Regimes for Stampede Reservoir Storage

The completion of Stampede Dam and Reservoir on the Little Truckee River contributed to reestablishing Truckee River flows suitable for cui-ui (FWS, 1992a). Since 1976, FWS has used water from Stampede Reservoir to adjust volume and timing of river flow to enhance cui-ui spawning runs and to maintain water temperatures suitable for egg incubation. In 1982, the U.S. District Court for the District of Nevada affirmed the Secretary's authority by ruling that the Secretary was to use "…the waters stored in Stampede Reservoir for the benefit of the Pyramid Lake fishery until such time as the cui-ui and LCT are no longer classified as threatened or endangered, or until sufficient water becomes available from other sources to conserve the cui-ui and LCT." The U.S. Ninth Circuit Court of Appeals affirmed this decision, and the U.S. Supreme Court declined to review the case. This gave cui-ui its only assured water supply.

Early management guidelines established flow regimes for the lower river (FWS, 1992a). The minimum management spawning flow during May and June was set at 1,000 cfs (approximately 60,000 acre-feet per month. Flows were not to exceed 2,500 cfs to reduce the potential for killing eggs and yolk-sac larvae by scouring and to enable adult movement

(Buchanan, 1987; Buchanan and Burge, 1988; Buchanan and Strekal, 1988). From January through April, 60,000 acre-feet of attraction flows were required.

In the mid-1990s, FWS-funded research led to the development of four variable flow recommendations for the Truckee River. Research conducted by The Nature Conservancy indicated that flow management that varies across seasons and across years was the optimum solution for meeting all ecosystem needs in a naturally variable riverine system with variable availability of water for environmental flows. The Nature Conservancy developed four flow management regimes for the lower Truckee River in 1995 (Gorley, 1996). FWS implemented these flow regimes using water stored in Stampede Reservoir in excess of fish water to enhance riparian recruitment, channel maintenance; aquatic and riparian ecosystem maintenance; and a survival flow regime for use as an emergency plan during extremely dry years. These flow regimes utilized by FWS from 1995 through 2000 resulted in substantial improvement in the riparian forest downstream from Derby Diversion Dam and in other sites along the Truckee River (TRIT, 2003).

Beginning in 2002, FWS, in cooperation with the Pyramid Tribe, replaced these four flow regimes by six-flow regimes with the intent that less water would be released in the spring and more would be releases in late summer and fall, resulting in measured releases of water in the Truckee River over the entire year. The strategy was designed to more closely mimic a natural river system while protecting habitat for both cui-ui and LCT. A successful cui-ui spawning event was supported in 2002 during an extreme dry year using only 23,000 acre-feet of storage water.

Such flow patterns also have proven effective in maintaining riparian trees and shrubs that established in the 1980s through droughts in the early and late 1990s (Rood et al., 2003). The six-flow regime recommendations are intended to provide the flexibility to implement an adaptive management strategy for the Truckee River. The recommended flows, which currently use Stampede (and a portion of Prosser Creek) Reservoir storage, vary according to the amount of water available in the system at any given time (table 3.29). Additional discussion of the six-flow regime is provided in the introduction to the Fish section and in the Biological Resources Appendix.

These ecosystem flows benefit both cui-ui and LCT, either directly or indirectly by maintaining or enhancing riparian vegetation, which provides shade along the river, thereby reducing the volume of water needed to maintain suitable temperatures for spawning and incubation. Alternatives in this revised DEIS/EIR would not alter the way in which FWS manages the six-flow regimes; the alternatives, however, may indirectly affect the amount of water available and the flow regime that can be achieved in any given year. Flow regimes 1, 2, and 3 are specifically designed to support cui-ui spawning runs.

2. Recovery Plan

The 1992 Revised Recovery Plan sets out four broad categories of conservation measures to improve and protect cui-ui spawning, incubation, and rearing habitat: (1) increase volume and improve timing of inflow to Pyramid Lake; (2) rehabilitate the lower Truckee River; (3) achieve water quality standards; and (4) improve fish passage in the lower Truckee River.

Much progress has been made in restoring the lower Truckee River as evidenced by implementation of the various flow regimes for management of Stampede Reservoir storage (Rood et al., 2003). Progress also has been made in improving fish passage at Marble Bluff Dam. Fish passage over the Truckee River delta has been improved recently because of rising Pyramid Lake elevations. Recent droughts, however, are again exacerbating delta conditions at the terminus of the Truckee River (Heki, 2004).

3. Fish Passage

Three major structures impede fish movements between Pyramid Lake and Derby Diversion Dam: Marble Bluff Dam, 3 miles upstream; Numana Dam, 8.3 miles upstream; Derby Diversion Dam itself, 34 miles upstream. There are also six small rock structures within the Pyramid Lake Reservation that impede passage.

a. Marble Bluff Dam

BOR constructed this dam and fish passageway in 1975 to reduce river headcutting and to provide passage of fish from the lake to the lower river. FWS manages the fish facility at Marble Bluff Dam, while BOR maintains the dam and fish lock. A state-of-the-art lock system at the dam provides a means of capturing fish as well as passage over the dam for fish which migrate via the river. The facility also includes a clay-lined fishway, with a capacity of 50 cfs that provides a 3-mile-long passageway to the Truckee River for both cui-ui and LCT to spawn and return to the lake when they are unable to migrate upriver either because of low river or lake elevations. The fishway terminates at the river though a bypass ladder installed in 1998 (Heki, 2004). Fish in the fishway can also be run through a fish handling building for sampling.

Flooding in January 1997 damaged the existing rock armoring of the dam, and BOR in conjunction with the Pyramid Tribe and FWS, repaired it in 1998. The 1997 flood caused extensive scouring in the channel downstream from the dam, altering the river hydraulics. A rock armored channel was constructed in 1998 to improve fish access to the fish lock. BOR, FWS and the Pyramid Tribe completed work on a major modification to the fish passage facility in 1998. The modifications provide a more efficient and reliable passage for cui-ui from Pyramid Lake to Truckee River. The modified facility handles approximately 10 times the number of fish per hour than the earlier design.

b. Numana Dam

This dam was constructed in 1917 to divert Truckee River water for agricultural purposes to the Pyramid Lake Indian Reservation. It is located about 8 miles off the Pyramid Lake shoreline. The fish ladder and screens were retrofitted in 1976 to facilitate fish passage but design limitations create a severe bottleneck for fish. By 2000 the screens were badly corroded and not functional. In 2001, COE began investigating a range of alternatives including a fish passage channel and removal of the dam. Currently, cui-ui are not provided access upstream of Numana Dam because adult and larval entrainment into the canal occurs. Numana Dam is a complete impediment to cui-ui and, therefore, impedes spawning success.

c. Derby Diversion Dam

This dam was completed in 1905. The dam, an integral part of the Newlands Project, diverts Truckee River water into the Truckee Canal for irrigation of the Truckee Division lands and for supplemental storage in Lahontan Reservoir on the Carson River for the Carson Division of the Newlands Project. A fish ladder was installed at Derby Diversion Dam in 1908, but the ladder is no longer functional. In 2002, BOR completed construction of the Derby Diversion Dam Fish Passage Project to provide passage to cui-ui and LCT past Derby Diversion Dam. The fishway is 935 feet long; large boulders in the fishway can be adjusted to control the velocity of water through the channel and to provide a resting spot for fish.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

For cui-ui, the analysis of alternatives focuses on habitat conditions related to spawning. The following indicators were evaluated:

1. Annual average inflow to Pyramid Lake.
2. Frequency (number of years) that flow regime 1, 2, or 3 is achieved in the lower Truckee River (between Numana and Marble Bluff Dams) from April through June.
3. Relative amounts of riparian vegetation along the lower Truckee River.

B. Summary of Effects

1. Average Annual Inflow to Pyramid Lake

Operations model results show that average annual inflow to Pyramid Lake is higher under TROA than under No Action or current conditions. Higher inflow would benefit cui-ui by maintaining Pyramid Lake at a higher elevation, which, in turn, would enhance lake habitat and river access. Average annual inflow to Pyramid Lake is lower under both No Action and LWSA than under current conditions, adversely affecting cui-ui. Table 3.60 summarizes these effects.

Table 3.60.—Summary of effects: average annual inflow (acre-feet) to Pyramid Lake
(+ = significant beneficial effect, - = significant adverse effect)

	Compared to current conditions			Compared to No Action	
	No Action	LWSA	TROA	LWSA	TROA
Net change	-	-	+	-	+

2. Frequency that Flow Regime 1, 2, or 3 Is Achieved in the Lower Truckee River from April through June

Overall, operations model results show that flow regimes 3 and higher are achieved about as frequently under LWSA and TROA as under No Action and as frequently under No Action, LWSA, and TROA as under current conditions. Under TROA, however, flow regime 1 or 2 is achieved more frequently in May and June, which would be a significant beneficial effect under TROA. Table 3.61 summarizes these effects.

Table 3.61.—Summary of effects: frequency that flow regime 1, 2, or 3 is achieved in the lower Truckee River
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">Month</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td>April</td><td colspan="2" rowspan="3">No effect</td><td>No effect</td><td rowspan="3">No effect</td><td>No effect</td></tr>
<tr><td>May</td><td>+</td><td>+</td></tr>
<tr><td>June</td><td>+</td><td>+</td></tr>
</table>

3. Relative Amounts of Riparian Habitat Along the Lower Truckee River

A significant beneficial effect on riparian habitat along the lower Truckee River in median, dry, and extremely dry hydrologic conditions would occur under TROA compared to both No Action and current conditions. Cui-ui would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. Significant beneficial effects on riparian habitat along the lower Truckee River in wet, median, and extremely dry hydrologic conditions would occur under No Action and LWSA when compared to current conditions. No effect would occur under LWSA when compared to No Action. Table 3.62 summarizes these effects.

Table 3.62.—Summary of effects: relative amounts of riparian habitat along the lower Truckee River
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">Hydrologic condition</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td>Wet</td><td>+</td><td colspan="2">No effect</td><td colspan="2">No effect</td></tr>
<tr><td>Median</td><td>+</td><td>+</td><td>+</td><td rowspan="3">No effect</td><td>+</td></tr>
<tr><td>Dry</td><td>No effect</td><td colspan="2">+</td><td>+</td></tr>
<tr><td>Extremely dry</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
</table>

C. Average Annual Inflow to Pyramid Lake

1. Method of Analysis

Operations model results were used to calculate average annual inflow to Pyramid Lake under current conditions and each alternative over the modeled 100-year period, based on flow at Nixon.

2. Threshold of Significance

An objective of the Cui-ui Recovery Plan is to increase Truckee River inflow to Pyramid Lake to enhance river access and habitat for spawning. Any change in inflow was considered significant.

3. Model Results

Table 3.63 presents operations model results for average annual inflow to Pyramid Lake.

Table 3.63.—Average annual inflow (acre-feet) to Pyramid Lake

Current conditions	No Action	LWSA	TROA
495,430	490,940	490,380	500,670

4. Evaluation of Effects

a. No Action

Operations model results show that average annual inflow to Pyramid Lake is 4,490 acre-feet less under No Action than under current conditions, which would result in a significant adverse effect.

b. LWSA

Average annual inflow to Pyramid Lake is 560 acre-feet less under LWSA than under No Action and 5,050 acre-feet less than under current conditions, which would result in a significant adverse effect under LWSA compared to No Action or current conditions.

c. TROA

Average annual inflow to Pyramid Lake is 9,730 acre-feet greater under TROA than under No Action and 5,240 acre-feet greater than under current conditions. Higher inflow is due to the conversion of M&I Credit Water to Fish Credit Water, in combination with increased return flow of groundwater from the sewage effluent reuse program. Water Quality Water accounts for the additional difference between TROA and current conditions. Higher average annual inflow would increase the elevation of Pyramid Lake. Higher inflow would result in improved adult and juvenile lake rearing habitat; improved adult migration conditions across Truckee River delta and into the lower Truckee River; and higher flows in spawning habitat in the lower Truckee River. The greatest benefits would occur in dry and very dry years, which are the most critical for cui-ui survival. These would be significant beneficial effects under TROA.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. A significant beneficial effect for cui-ui would occur under TROA because annual average inflow to Pyramid Lake would be greater.

D. Frequency that Flow Regime 1, 2, or 3 Is Achieved in the Lower Truckee River from April through June

1. Method of Analysis

Operations model results were used to calculate the frequency (number of years over the 100-year modeled period) that the average monthly flows for regime 1, 2, or 3 are achieved, based on flow at Nixon, from April through June, the period of cui-ui spawning.

2. Threshold of Significance

The number of years that flow regime 1, 2, or 3 is achieved from April though June was compared. It was assumed that flow regime 1 would be more beneficial for cui-ui than flow regime 2, and flow regime 2 would be more beneficial than flow regime 3.

3. Model Results

Table 3.64 presents operations model results for the frequency (number of years) that flow regime 1, 2, or 3 is achieved in the lower Truckee River from April through June.

Table 3.64.—Frequency (number of years) that flow regime 1, 2, or 3 is achieved in the lower Truckee River from April through June

Flow regime (flow recommendation)	Current conditions	No Action	LWSA	TROA
April				
1 (flow ≥ 590 cfs)	68	64	64	62
2 (flow ≥ 490 cfs)	8	9	8	11
3 (flow ≥ 420 cfs)	5	5	6	4
April total (1 + 2 + 3)	81	78	78	77
May				
1 (flow ≥ 1000 cfs)	57	56	56	55
2 (flow ≥ 800 cfs)	7	7	7	11
3 (flow ≥ 600 cfs)	10	12	12	7
May total (1 + 2 + 3)	74	75	75	73
June				
1 (flow ≥ 800 cfs)	48	48	48	49
2 (flow ≥ 600 cfs)	8	8	8	14
3 (flow ≥ 500 cfs)	13	12	12	5
June total (1 + 2 + 3)	69	68	68	68

4. Evaluation of Effects

a. No Action

Operations model results show that flow regimes 3 and higher are achieved 3 fewer times in April, 1 more time in May, and 1 fewer time in June under No Action than under current conditions. These differences would be unlikely to have a significant effect on the cui-ui population.

b. LWSA

Flow regimes 3 and higher are achieved as frequently under LWSA as under No Action and current conditions except for two minor differences. These differences would be unlikely to have an effect on the cui-ui population.

c. TROA

Flow regimes 3 and higher are achieved 1 fewer time in each of the three months under TROA than under No Action, which would be unlikely to have a significant effect. Flow regimes 2 and higher, however, are achieved 3 percent more frequently in May and 7 percent more frequently in June. This moderate difference likely would benefit cui-ui spawning and, therefore, would be a significant beneficial effect when TROA is compared to No Action.

Flow regimes 3 and higher are achieved 4 fewer times in April and 1 fewer time in May and June under TROA than under current conditions. Flow regime 2 and higher, however, are achieved only 3 percent less frequently in April, 2 percent more frequently in May, and 7 percent more frequently in June. This moderate difference would be likely to benefit cui-ui spawning and, therefore, would be a significant beneficial effect when TROA is compared to current conditions.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. A significant beneficial effect for cui-ui would occur under TROA because flow regimes 1 and 2 would be achieved more frequently in May and June than under No Action or current conditions.

E. Relative Amounts of Riparian Habitat along the Lower Truckee River

See "Riparian Habitat and Riparian-Associated Wildlife" for discussions of method of analysis and threshold of significance. For the cui-ui analysis, only riparian habitat downstream from Derby Diversion Dam was evaluated.

1. Evaluation of Effects

a. No Action

Compared to current conditions, a significant beneficial effect on riparian habitat along the lower Truckee River would occur under No Action in wet, median, and extremely dry conditions. Cui-ui would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. See more detailed discussion in “Riparian Habitat and Riparian-Associated Wildlife.”

b. LWSA

When compared to No Action, riparian habitat along the lower Truckee River would not be affected under LWSA. Compared to current conditions, a significant beneficial effect on riparian habitat along the lower Truckee River in median and extremely dry hydrologic conditions would occur under LWSA. Cui-ui would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. See more detailed discussion in “Riparian Habitat and Riparian-Associated Wildlife.”

c. TROA

When compared to both No Action and current conditions, a significant beneficial effect on riparian habitat in median, dry, and extremely dry hydrologic conditions would occur under TROA. Cui-ui would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. See more detailed discussion in “Riparian Habitat and Riparian-Associated Wildlife.”

2. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. Enhancing riparian habitat along the lower Truckee River, thereby reducing water temperatures through shading effects, would be a significant beneficial effect under TROA.

LAHONTAN CUTTHROAT TROUT

I. AFFECTED ENVIRONMENT

A. Status and Distribution

Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) is an inland subspecies of cutthroat trout endemic to the Lahontan basin of northern Nevada, eastern California and southern Oregon. It was listed by FWS as endangered in 1970 (35 FR 13520, August 25, 1970) and later reclassified as threatened in 1975 to facilitate management and allow regulated angling (40 FR, 29864, July 16, 1975). A recovery plan was issued in 1995. There is no designated critical habitat. LCT has been introduced into habitats outside its native range, consistent with the recovery plan.

The LCT Recovery Plan estimated that less than 0.2 percent of lake habitat and about 2.2 percent of stream habitat in the Truckee River basin were occupied by LCT (FWS, 1995b). The only remaining indigenous population resides in Independence Lake and the main inlet tributary Independence Creek (Peacock et al., 1999). LCT within the Truckee River basin is included in the Western Lahontan Basin population segment, one of three population segments of LCT. Within the Truckee River basin, there are currently seven small headwater tributaries with a total of 8 miles that support self-sustaining river populations. These populations are found in Independence Creek, Pole Creek, Upper Truckee River, Bronco Creek, Hill Creek, and West Fork Gray Creek. There are two lake populations in Pyramid and Independence Lakes. Only Independence Lake has a naturally reproducing population. Pyramid Lake has a hatchery-maintained population.

LCT occupied about 360 miles of suitable stream habitat and 284,000 acres of lake habitat within the Truckee River basin prior to the 1860s (Gerstung, 1986). The largest populations of LCT occurred in Pyramid Lake and Lake Tahoe, where the fish was a major food source, along with the cui-ui, for local Indians.

1. Pyramid Lake

By 1944, the original Pyramid Lake LCT population was extirpated after it lost access to its Truckee River spawning grounds due to Derby Diversion Dam, pollution, commercial harvest and exotic fish introductions into the main Truckee River system (Sumner, 1940; Gerstung, 1988; Knack and Stewart, 1984; Behnke, 1992). Hatchery stocking developed a popular LCT sport fishery at Pyramid Lake. Four strains of LCT (Heenan, Walker, Summit and Independence Lakes) were used for stocking into Pyramid Lake until the 1980s (Coleman and Johnson, 1988). Since the early 1980s, LCT eggs have been taken exclusively from Pyramid Lake spawners and reared for release (FWS, 1995b).

2. Lake Tahoe

The native Lake Tahoe LCT population was extirpated in 1939 as a result of damage to spawning tributaries from pollution, logging, diversions and dams; overfishing; and the inability to compete with the introduced lake trout (Gerstung, 1986, 1988; Behnke, 1992).

3. Independence Lake

Independence Lake has the only self-sustaining lake LCT population in the Truckee River basin. This population is genetically unique (Cowan, 1988; Bartley and Gall, 1993) and is vulnerable to extinction (FWS, 1995b). The lake supports a small catch-and-release fishery, and historically supported spawning runs of 2,000 to 3,000 fish (Welch, 1929). By 1960, the population had declined to less than 100 spawners per year (Gerstung, 1988), despite many attempts to supplement this population with hatchery-reared native Independence Lake LCT stock. The population decline is thought to be the result of competition with non-native kokanee salmon in the lake and brook trout in the stream. Additionally, a sand/silt delta has formed where Independence Creek enters the lake, which blocks LCT spawning runs into the creek when lake storage is less than 7,500 acre-feet (FWS, 1995b).

B. Life History

River- and lake-adapted forms of LCT have different behavior, ecology and habitat use. Optimal river habitat is characterized by the following: (1) clear cold water with an average maximum summer temperature of less than 22 ºC (72 ºF), and relatively stable summer temperature regime averaging about 13 ºC (55 ºF) plus or minus 4 ºC (7 ºF); (2) pools in close proximity to cover and velocity breaks to provide hiding cover and spawning areas; (3) well vegetated, stable stream banks; (4) 50 percent or more of stream area providing cover; and (5) a relatively silt free rocky substrate in riffle-run areas (FWS, 1995b). Optimal lake habitat is characterized by: (1) clear, cool/cold water with an average summer surface layer temperature of less than 72 ºF; (2) a surface layer with a pH of 6.5 to 8.5 and dissolved oxygen content of less than 8 milligrams per liter (mg/L); and (3) access to spawning tributaries.

LCT is an obligate stream spawner. Spawning occurs from February through July, depending on flow, elevation, and water temperatures. Historically, populations in Pyramid and Winnemucca Lakes migrated more than 100 miles up the Truckee River through Lake Tahoe to headwaters in its tributaries to spawn (Sumner, 1940; La Rivers, 1962). The upper river provided the cool water temperatures needed for spawning and fry and for juvenile rearing. The most important LCT spawning habitat in the Truckee River was upstream of Verdi, Nevada.

Providing spawning opportunities and permanent rearing habitat for LCT in the lower reaches of the Truckee River has been unachievable because of seasonal high water temperatures, lack of spawning habitat, high sediment loads, variable flows downstream from diversions, and lack of passage at Derby Diversion Dam. Cooperative efforts are ongoing to improve riparian and riverine habitat. Spawning downstream from Derby Diversion Dam is not an objective for LCT because they probably never spawned (or reared) in the lowest reaches.

Access to historic spawning habitat in the upper Truckee River is blocked by more than 10 dams and water diversion structures (TRIT, 2003). Some progress in improving passage has been made with the renovation of Marble Bluff Dam (1999) and completion of the Derby Diversion Dam fish ladder (2002).

Trout populations in the Truckee River basin are predominantly non-native. Rainbow, brook, brown, and lake trout as well as kokanee salmon have been stocked into Truckee basin waters over the last century (Peacock et al., 1999). Most of these species compete with LCT and are at least partially responsible for extirpation of the native strain that occupied the Truckee River basin. Rainbow trout, a closely related species, spawns at the same time and in the same habitats as LCT, with which it can hybridize (TRIT, 2003). Kokanee and lake trout are particularly detrimental to lake LCT populations. In lakes, kokanee successfully compete for zooplankton, a major LCT food source (Behnke, 1992) and lake trout are efficient predators of LCT.

C. Management

Fish passage and flow management described for cui-ui also apply to LCT restoration.

1. Recovery Plan

In 1995, FWS released the LCT Recovery Plan encompassing six river basins within LCT historic range, including the Truckee River basin. The plan identified five conditions contributing to the decline and affecting the potential for recovery of LCT in the Truckee River basin: (1) reduction and alteration of streamflow and discharge; (2) alteration of stream channels and morphology; (3) degradation of water quality; (4) reduction of Pyramid Lake elevation and concentration of chemical components; and (5) introductions of non-native fish species. Recently, a Short-Term Action Plan for Lahontan Cutthroat Trout in the Truckee River Basin was released (TRIT, 2003). This plan focuses on gathering information about habitat requirements and implementing demonstration projects and research.

2. Hatchery Stocking

In addition to various habitat restoration measures, CDFG, NDOW, FWS, and the Pyramid Tribe are actively engaged in LCT stocking efforts in the Truckee River Basin. Since the extirpation of the original Pyramid Lake strain of LCT, the fishery has been maintained by a hatchery stocking program currently operated by the Pyramid Lake Paiute Tribal Fishery Program and FWS. Several strains of LCT from other waters were planted in Pyramid Lake to redevelop the fishery. The fishery is currently sustained by capturing LCT during the spawning period, taking spawn, and hatching the fish at the Numana Tribal Fish Hatchery and the Lahontan National Fish Hatchery (LNFH). Most LCT are captured at the Sutcliffe spawning facility. FWS has funded genetic research on this species to improve understanding of the origins of out-of-basin populations. Based on this research (TRIT, 2003), LNFH has developed a brood stock of the Pilot Peak strain, believed to be original Pyramid Lake stock. FWS is using this strain in the Truckee River and Fallen Leaf Lake.

The LCT recovery program has stocked LCT out of its historic range into headwaters tributaries with barriers to protect the LCT from hybridization with nonnative rainbow trout since 1996. Six streams with a total length of 30 miles have been stocked.

In 2003, about 30,000 catchable sized LCT were released in the Truckee River between Tahoe City and Truckee. The purpose of this effort is to gain information to improve understanding of the conservation needs of LCT in the Truckee River Basin (Heki, 2004). This is a small part of a broader effort to reestablish LCT in the watershed.

In the lower Truckee River, NDOW, FWS, and the Pyramid Tribe conducted a 5-year project to assess movement patterns and survival of stocked LCT and public interest. A total of 50,000 8-inch LCT were stocked into the river (Heki, 2004).

In 2003, NDOW and the Pyramid Tribe cooperated on the release of 2,200 mature LCT between Fisherman's Park in Reno upstream to Crystal Peak Park in Verdi. The introduction of these fish marked the beginning of a 5-year study to determine the feasibility of restoring LCT to the Truckee River. Fish were collected during the spawning run at Pyramid Lake and ranged in size from 18 inches to 24 inches. The fish will be monitored to determine spawning locations and potential for spawning success (http://ndow.org/fish/forecast/west.shtm).

3. Riparian Vegetation Restoration

These surveys found that narrow bands of Fremont cottonwood with some sandbar and black willow became established in 1983 and 1987 along the lower Truckee River as an unplanned consequence of flow regulation directed toward the spawning needs of the cui-ui (Rood et al., 2003). These stands of cottonwoods and willows provided the basis for streamflow prescriptions designed to promote seedling establishment from 1995 through 2000 (TRIT, 2003). These flows enabled further seedling establishment. An important feature of these flows is a gradual decrease of flows during the critical seedling establishment period.

The establishment of riparian forests in the lower Truckee River and the increased understanding of flow requirements that promote seedling establishment and survival has tremendous consequences for re-establishing LCT in the lower Truckee River. Re-establishment of cottonwoods and willows has altered sediment scour and deposition resulting in a narrower deeper channel. The deepening of the channel along with shading has resulted in cooler water temperatures, and reduced erosion and sedimentation. In 1999, in contrast to prior years, trout were observed in the lower Truckee River throughout the summer (Rood et al., 2003).

II. Environmental Consequences

A. Introduction

This analysis focuses on how modifying operations of Truckee River reservoirs would affect the habitat and management efforts for LCT. Two recovery criteria set forth in the 2003 Short-Term Action Plan are relevant to the operations alternatives considered in this study: (1) Truckee River water is managed to support LCT migration, life history, and habitat requirements and (2) threats to LCT and its habitat have been reduced or modified to where they no longer represent a threat of extinction or irreversible population decline.

The following three indicators were selected to analyze potential effects:

1. Average annual inflow to Pyramid Lake.
2. Relative amounts of riparian vegetation along the lower Truckee River.
3. LCT spawning access to Independence Creek in dry and extremely dry hydrologic conditions.

B. Summary of Effects

Operations model results show that average annual inflow to Pyramid Lake is higher under TROA than under No Action or current conditions. Higher inflow would benefit LCT by maintaining Pyramid Lake at a higher elevation, which would enhance lake habitat and river access. Average annual inflow to Pyramid Lake is lower under both No Action and LWSA than under current conditions, which would adversely affect LCT. Table 3.59 summarizes these effects.

Significant beneficial effects to riparian habitat along the lower Truckee River in median, dry and extremely dry hydrologic conditions would occur under TROA. LCT would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. Significant beneficial effects to riparian habitat along the lower Truckee River in wet, median, and extremely dry hydrologic conditions would occur under LWSA and No Action. The effect would be the same under LWSA as under No Action. Table 3.61 summarizes these effects.

TROA would result in a significant beneficial effect by providing additional access to Independence Creek in August, when compared to current conditions, and in July and August when compared to No Action. Under both No Action and LWSA, a significant adverse effect compared to current conditions would occur in July and August. In addition, TROA provides that CDFG can direct Sierra Pacific to provide and maintain a fish channel through the Independence Creek delta should storage in Independence Lake drop below 7,500 acre-feet. This condition would not apply under No Action or current conditions. Table 3.65 summarizes these effects.

Table 3.65.—Summary of effects: LCT spawning access to Independence Creek in dry and extremely dry hydrologic conditions
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th></th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>Spawning Period</th><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td>May</td><td colspan="3" rowspan="2">No effect</td><td rowspan="4">No effect</td><td rowspan="2">No effect</td></tr>
<tr><td>June</td></tr>
<tr><td>July</td><td>-</td><td>-</td><td>No effect</td><td>+</td></tr>
<tr><td>August</td><td>-</td><td>-</td><td>+</td><td>+</td></tr>
</table>

C. Average Annual Inflow to Pyramid Lake

See discussions of method of analysis, threshold of significance, model results, and evaluation of effects in “Cui-ui.” The exception is that for the threshold of significance, the LCT Recovery Criteria (TRIT, 2003) for Pyramid Lake calls for obtaining water through water right purchases or other means to protect a secure and stable Pyramid Lake ecosystem and meet life history and habitat requirements of LCT. Also, no mitigation would be required because no significant adverse effects would occur under TROA. TROA would provide a significant beneficial effect for LCT by increasing the amount of average annual inflow to Pyramid Lake and improving riverine habitat through management of dedicated water.

D. Relative Amounts of Riparian Vegetation Along the Lower Truckee River

See discussions of method of analysis, threshold of significance, and model results in “Riparian Habitat and Riparian-Associated Wildlife.”

1. Evaluation of Effects

a. No Action

A significant beneficial effect on riparian habitat along the lower Truckee River in wet, median, and extremely dry hydrologic conditions would occur under No Action. LCT would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. See the more detailed discussion of effects in “Riparian Habitat and Riparian-Associated Wildlife.”

b. LWSA

The effect on riparian habitat along the lower Truckee River would be the same under LWSA as under No Action.

c. TROA

A significant beneficial effect on riparian habitat in median, dry, and extremely dry hydrologic conditions would occur under TROA when compared to both No Action and current conditions. LCT would be likely to indirectly benefit from cooler water temperatures as a result of shading by riparian vegetation. See the more detailed discussion of effects in "Riparian Habitat and Riparian-Associated Wildlife."

2. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. TROA would provide a significant beneficial effect for LCT by enhancing riparian habitat along the lower Truckee River, thereby reducing water temperatures through shading effects.

E. Access to Independence Creek for Spawning LCT

1. Method of Analysis

Operations model results were used to determine Independence Lake storage under current conditions and the alternatives. All water years were examined, but only dry and extremely dry hydrologic conditions are highlighted because storage does not fall to 7,500 acre-feet in other hydrologic conditions.

2. Threshold of Significance

LCT access to the spawning habitat in Independence Creek is blocked by the delta when Independence Lake storage is at or below 7,500 acre-feet. Any change in the number of times that storage is at or below 7,500 acre-feet was considered significant.

3. Model Results

Table 3.66 presents operations model results for the differences in the number of years (out of 100) that Independence Lake storage is at or below 7,500 acre-feet during the LCT spawning period.

Table 3.66.—Difference in number of years (out of 100) that Independence Lake storage is at or below 7,500 acre feet during the LCT spawning period

	Compared to current conditions			Compared to No Action	
	No Action	LWSA	TROA	LWSA	TROA
May	0	0	0	0	0
June	0	0	0	0	0
July	+1	+1	0	0	-1
August	+1	+1	-1	0	-1

4. Evaluation of Effects

a. No Action

Operations model results show that storage in Independence Lake falls below 7,500 acre-feet one more time under No Action than under current conditions in July and August. Because of the extreme vulnerability of the LCT population in Independence Creek, any potential loss of access to its spawning habitat would be a significant adverse effect.

b. LWSA

Operations model results and effects are the same under LWSA as under No Action.

c. TROA

Independence Lake falls below 7,500 acre-feet one fewer time under TROA than under No Action in July and August. There are no differences in May and June. Independence Lake falls below the 7,500 acre-feet threshold one fewer time under TROA than under current conditions in August; there are no differences in May, June, or July. TROA provides that CDFG can direct Sierra Pacific to provide and maintain a fish channel through the Independence Creek delta should Independence Lake storage drop below 7,500 acre-feet. This condition would not apply under No Action or current conditions. The additional opportunities to provide spawning access for the Independence Lake LCT population would be significant beneficial effects under TROA.

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. TROA would provide a significant beneficial effect for LCT by reducing the number of times that Independence Lake falls below 7,500 acre-feet and by providing the ability for CDFG to direct Sierra Pacific to provide and maintain a fish channel though the Independence Creel delta should storage fall below 7,500 acre-feet.

BALD EAGLE

I. AFFECTED ENVIRONMENT

The threatened bald eagle historically nested at Pyramid Lake and Lake Tahoe (Cantrell, 1989). Bald eagles were last known to nest at Pyramid Lake in 1866 (Alcorn, 1988). Since 1997 bald eagles have nested at Emerald Bay along the southwest part of Lake Tahoe (Jurek, 2003). From 2001 to 2003 bald eagles attempted to nest near Marlette Lake, just inland from the east central shore of Lake Tahoe (Espinosa, 2003). Currently, bald eagles nest at Independence Lake and Stampede, Boca Reservoir, and Lahontan Reservoirs. Other bald eagles could nest within the study area (Jurek, 2003).

In the study area, bald eagles winter at Lake Tahoe, along the Truckee River, and at ice-free lakes and reservoirs. Winter bald eagle surveys at Lake Tahoe recorded 4 to 20 birds annually (USDA, 1998). Lahontan Reservoir is also a bald eagle wintering area. The use of wintering areas is usually traditional, but is also dependent on a reliable food supply (Herron et al., 1985). The arrival of wintering bald eagles in the upper elevations of the study area generally coincides with the peak of kokanee spawning in Taylor Creek and the Little Truckee River, which occurs around mid-October. Wintering bald eagles usually leave the Lake Tahoe area around March (Cantrell, 1989).

Live or dead fish, as well as rodents, small mammals, and other birds may be part of a bald eagle diet in the Great Basin (Ryser, 1985). Most live fish that were observed taken from reservoirs by bald eagles were captured in water more than 6 feet deep (BioSystems, 1992). Eagles cannot reach prey at depths greater than about 2 feet; forages observed over deeper water are likely to be for prey floating on or swimming near the surface. No data exist on the relative importance of native and stocked fish in the diet of nesting bald eagles at Independence Lake and Stampede, Boca, and Lahontan Reservoirs. Both live fish and carrion, are available to bald eagles (BioSystems, 1992). Tui chub and Tahoe sucker, which are common in local reservoirs, are the major prey items for bald eagles at other California reservoirs. In addition, tui chub and Tahoe sucker spawn in shallow waters during the bald eagle nesting season, which makes them vulnerable to bald eagle predation. LCT is also a likely forage species at Independence Lake during the April through June spawning season. Eagles may also take advantage of recently released hatchery fish that die or undergo stress and fish injured by anglers. A variety of non-native fish species have been introduced into Lahontan Reservoir (NDOW, 2004). Of these, crappie, channel catfish and bass have been shown to be an important component of bald eagle diet on Arizona reservoirs (BioSystems, 1992).

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

The analysis of the effects on bald eagle was based on the analyses of the effects on the primary prey base of bald eagles: fish in lakes and reservoirs. Two indicators were selected for this analysis:

1. Fish survival based on minimum storage thresholds (Stampede, Boca, and Lahontan Reservoirs)

2. Spring/summer shallow water spawning habitat (Lake Tahoe, Independence Lake, and Lahontan Reservoir)

B. Summary of Effects

Table 3.67 presents a summary of the effects on the primary prey base of bald eagles: fish in lakes and reservoirs.

Table 3.67.—Summary of effects: bald eagle prey base
(+ = significant beneficial effect, - = significant adverse effect)

<table>
<tr><th rowspan="2">Lake/reservoir</th><th colspan="3">Compared to current conditions</th><th colspan="2">Compared to No Action</th></tr>
<tr><th>No Action</th><th>LWSA</th><th>TROA</th><th>LWSA</th><th>TROA</th></tr>
<tr><td colspan="6">Fish survival</td></tr>
<tr><td>Stampede</td><td>+</td><td>No effect</td><td>+</td><td>-</td><td>+</td></tr>
<tr><td>Boca</td><td colspan="2">No effect</td><td>+</td><td>No effect</td><td>+</td></tr>
<tr><td>Lahontan</td><td colspan="5">No effect</td></tr>
<tr><td colspan="6">Spring/summer shallow water spawning habitat</td></tr>
<tr><td>Tahoe</td><td colspan="5" rowspan="3">No effect</td></tr>
<tr><td>Independence</td></tr>
<tr><td>Lahontan</td></tr>
</table>

C. Fish Survival

1. Method of Analysis

See discussion in “Fish in Lakes and Reservoirs.”

2. Threshold of Significance

Bald eagles at Lake Tahoe, Independence Lake, and Stampede, Boca , and Lahontan Reservoirs could be adversely affected if reservoir storage were to fall below current volumes at a sufficient magnitude and frequency to significantly affect fish survival, the eagles’ prey base. The significance of differences among the comparisons was based on best professional judgment.

3. Model Results

See model results in “Fish in Lakes and Reservoirs.”

4. Evaluation of Effects

See discussion in “Fish in Lakes and Reservoirs.”

5. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under TROA. A significant beneficial effect would occur under TROA because storage in Stampede and Boca Reservoirs would fall below the minimum thresholds much less frequently under TROA than under No Action or current conditions.

TAHOE YELLOW CRESS

I. AFFECTED ENVIRONMENT

Tahoe yellow cress is a Federal candidate plant species and is listed by California as endangered and by Nevada as critically endangered. In the world, Tahoe yellow cress is found only in scattered populations around the shore zone of Lake Tahoe. The highest number of populations is located on the south and west shores where the greatest amount of sandy beach habitat occurs (California State Lands Commission [CSLC], 1998). The Conservation Strategy for Tahoe yellow cress (Pavlik et al., 2002) was developed to guide the conservation and management of Tahoe yellow cress and its habitat. A Memorandum of Understanding (MOU) was signed to ensure implementation of the protective measures identified in the conservation strategy. The parties to this MOU are Tahoe Lakefront Owners Association; League to Save Lake Tahoe; Tahoe Regional Planning Agency; California Department of Fish and Game; California Department of Parks and Recreation; California Tahoe Conservancy, California State Lands Commission; Nevada Division of Forestry; Nevada Division of State Parks; Nevada Division of State Lands; Nevada Natural Heritage Program; FWS; and USFS. Successful implementation of this strategy should obviate listing this species under ESA.

As part of the Conservation Strategy, occurrence data over the period since the plant species was first scientifically described in 1941 were analyzed. The analysis showed that although Tahoe yellow cress had been observed or collected from 51 locations, not all known occurrences have been occupied at the same time. In fact, the species has been shown to occupy nearly 80 percent of its known habitat during the best of conditions and as little as 20 percent during the worst (Pavlik et al., 2002). This is typical of a highly dynamic species that has the ability to expand its population in response to favorable conditions (low lake water) and contract and persist through periods when conditions are less favorable (high lake water).

These data show a strong correlation between lake elevation and Tahoe yellow cress presence. During the drought years 1989 to 1994, when the mean lake elevation was 6,222.8 feet, the plant was present at 89 percent of the known sites on an estimated 1,863 acres. During the wet years from 1995 to 2000, the mean lake elevation was 6227.7 feet, and the plant was present at 32.8 percent of known sites on an estimated 233 acres (Pavlik et al., 2002).

Much Tahoe yellow cress habitat is popular for recreation and associated use, such as facility development and construction, and beach property maintenance (beach raking and clearing) which have been documented as sources of disturbance to the plant and its habitat (TRPA, 1995; CSLC, 1998). The habitat is also subject to various natural physical processes, including the erosive forces of waves and wind and fluctuation of lake elevations (TRPA, 1995). Wave action during high water periods affects the shoreline and can alter beaches. During such events, aerial stems and rootstocks of the plant can be washed away (Josselyn et al., 1992). Wave action can also have a positive benefit for the plant by creating foreshore berms (a relatively flat bench that slopes towards shore and is limited by a steeper slope closer to the lake). Plants may concentrate in low areas created by these berms that offer higher moisture concentrations or protection from wave action.

Under current conditions, dam operations alter the historical seasonal fluctuation of the lake, maintaining higher elevations in spring and summer, the growing season for Tahoe yellow cress (Stone, 1991 as cited in Josselyn et al., 1992). The effect of prolonged inundation on Tahoe yellow cress is not fully known. Although data indicate the species has some mechanism for surviving periods of inundation, maintaining Lake Tahoe at its maximum elevation of 6229.1 feet for long periods of time could adversely affect the survival of certain populations (Josselyn et al., 1992; Ferreira, 1987). In accordance with the Truckee River Agreement of 1935, the legal maximum lake elevation is 6229.1 feet. While the lake has dropped below its rim elevation (6223.0 feet) for extended periods of time during drought situations, the legal maximum elevation has rarely been exceeded for any substantial length of time since 1935.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

The Tahoe Yellow Cress Conservation Strategy (Pavlik et al., 2002) lists five major factors that contribute to the current status of the species:

1. Alterations in lake level dynamics caused by construction and operations of the Truckee River outlet dam and reservoir.

2. Destruction of actual and potentially suitable habitat by the construction of piers, jetties, and other structures.

3. High levels of recreation activities associated with beaches and dunes.

4. Disturbance of the beach sand by public and private property maintenance activities.

5. Possible stochastic environmental events.

Modifying operations of Truckee River reservoirs could influence Tahoe yellow cress by altering lake level dynamics and changing the amount of available shore zone habitat. In addition, if lake levels were markedly increased at high lake elevations, increases in trampling in the reduced available habitat could adversely affect Tahoe yellow cress. Because the number of populations of Tahoe yellow cress that are present in any given year is dependent upon available habitat, which is determined primarily by the elevation of Lake Tahoe, lake elevation provides the best indicator of change or significant effects caused by changes in management of water in Lake Tahoe.

B. Summary of Effects

Operations model results show that slightly more shore zone habitat is available for Tahoe yellow cress during most months of the primary growing season (May through September) in dry hydrologic conditions under TROA than under No Action and current conditions. The greater available habitat, however, is less than 1 percent of the total potential habitat and would not be a significant effect. On average, in median hydrologic conditions, 20 fewer acres are available under TROA than under No Action and about 6 fewer acres than under current conditions. Both are differences of less than 1 percent of the total available habitat. In wet hydrologic conditions, about the same amount of habitat is available under TROA as under No Action, and about 2 acres more than under current conditions. None of these small differences constitute a significant effect (table 3.68).

Table 3.68.—Summary of effects: available and total potential habitat for Tahoe yellow cress during the primary growing season (May through September)
(+ = significant beneficial effect, - = significant adverse effect)

Hydrologic Condition	Compared to current conditions			Compared to No Action	
	No Action	LWSA	TROA	LWSA	TROA
Wet	No effect				
Median					
Dry					

C. Method of Analysis

To determine potential effects, this analysis compared the area of available shore zone habitat in wet, median and dry hydrologic conditions during the primary growing season (May through September), based on lake elevation. Monthly lake elevations from the operations model were used to calculate the habitat area. The maximum modeled lake elevation is 6229.0 feet, where the amount of available shore zone habitat is considered to be zero. The minimum modeled lake elevation of 6220.05 feet corresponds to the maximum available habitat of 2,752 acres. Habitat area markedly decreases area between elevation 6227 feet, when 35 percent (972 acres) of the shore zone is exposed, and elevation 6228 feet, when only 9 percent (238 acres) is exposed (table 3.69).

Table 3.69.—Amount of shore zone habitat available at lake elevations 6220 to 6229 feet

Lake elevation (feet)	Shore zone habitat (acres)	Percent of total habitat
6220	2752	100
6221	2401	87
6222	2115	77
6223	1862	68
6224	1658	60
6225	1458	53
6226	1236	45
6227	972	35
6228	238	9
6229	0	0

Soil inundation during the spring and summer inhibits vegetative growth and can delay the onset of flowering of Tahoe yellow cress. Flooding during late stages of the growing season can also inhibit or delay reproduction of the species (Pavlik et al., 2002). The analysis includes a comparison of lake elevations, peak elevations, and declines in elevation during the primary growing season in wet, median and dry hydrologic conditions.

Annual surveys have been conducted for Tahoe yellow cress since 1979 and are annually summarized by CSLC. The 2002 survey report states that the optimal lake elevation to ensure the persistence of the population is 6225 feet or below. Above elevation 6225 feet, there is a statistically significant decline in the number of occupied sites (CSLC, 2003). Lake elevations recorded in the annual surveys and referenced in the CSLC report correspond to the elevation when the annual survey was conducted, generally late August or early September. The operations model generates end-of-month elevations. End-of-August elevations were used to compare the number of years that lake elevations are below 6225 feet, creating preferred conditions for Tahoe yellow cress.

Tahoe yellow cress habitat could also be adversely affected by the concentration of human activities in narrow shore zone habitat areas during high water years. Not only is the amount of habitat greatly reduced at lake elevations above 6227 feet, but recreational activities are concentrated in this narrow zone of habitat which could increase the trampling of the plants and modify the habitat. Monthly elevations during the growing season (generated from the operations model) were used to calculate the number of years that lake elevations exceeded 6227, 6228, and 6229 feet under each alternative. Elevations that exceeded the selected elevation for any month of the growing season were recorded.

D. Threshold of Significance

Successful implementation of the Conservation Strategy should preclude the need to list Tahoe yellow cress under ESA. Because of its special status, a significant effect would be a reduction in the average amount of shore zone habitat available to the species. Given the understanding of the species biology presented in the Conservation Strategy, it is expected that fluctuations in lake elevations within usual climatic variation are not significant in the long run. Significant adverse effects could occur if increased high water elevations occurred and restricted core populations were not protected from trampling and other habitat destruction, or if elevations were increased and kept atypically high. Signatories to the MOU to implement the Conservation Strategy have committed to protecting sites from trampling at high water.

TRPA has developed a threshold standard for Tahoe yellow cress based on a minimum number of population sites (26) for maintaining the species. The threshold is considered to be in “attainment” when there is a minimum number of populations for the species and the population is protected from adverse effect. TRPA evaluates the species every 5 years and considered the Tahoe yellow cress population to be in “non-attainment” status in 1991, 1996, and 2001 (TRPA, 2002). The threshold of 26 population sites set by TRPA is achievable only in drought years (table 3.69; figure 3.28) and is only met in those years when the lake elevation is at or below 6225 feet. This threshold was not chosen for this analysis because the method is not based on the most current knowledge of the species.

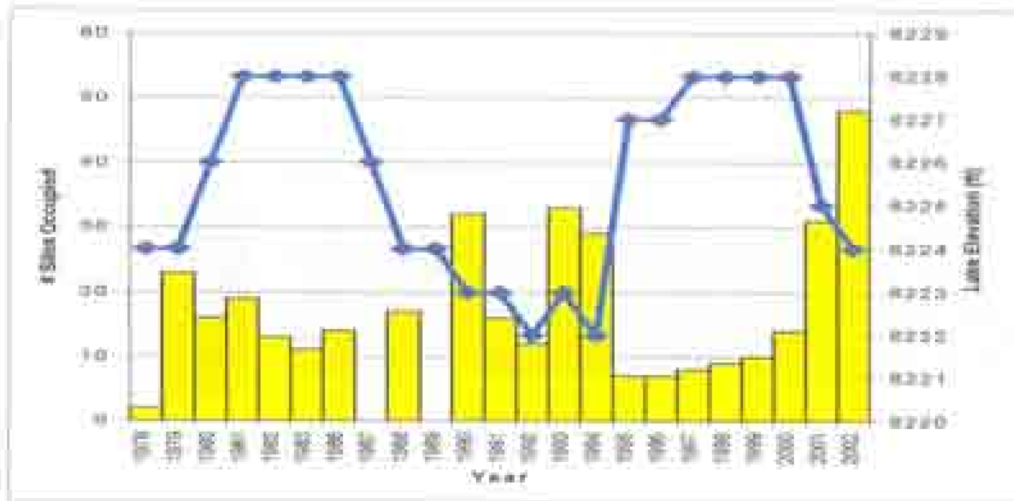


Figure 3.28.—Lake elevation and number of Tahoe yellow cress sites occupied by survey year (blue line = lake elevation) (CSLC, 2003).

E. Model Results

Table 3.70 presents operations model results for the area of available habitat and percent of total potential habitat for Tahoe yellow cress in each month of the growing season.

F. Evaluation of Effects

1. No Action

Operations model results show that slightly more shore zone habitat is available for Tahoe yellow cress under No Action than under current conditions in most months of the primary growing season (May through September) in all three hydrologic conditions. An average of about 12 acres more is available in dry hydrologic conditions; 14 acres more in median hydrologic conditions; and 2 acres more in wet hydrologic conditions.

Soil saturation and inundation during the spring and summer, which can inhibit vegetative growth and delay the onset of flowering, would be no greater under No Action than under current conditions. The small difference in available habitat between No Action and current conditions represents less than 1 percent of the total potential habitat, and would not be a significant effect.

2. LWSA

About 1 acre more of shore zone habitat is available in each month in dry hydrologic conditions; up to 2 acres more in median hydrologic conditions, and the same amount in wet hydrologic conditions under LWSA as under No Action. All differences are less than 1 percent of the total potential habitat for Tahoe yellow cress.

Table 3.70.—Monthly and average growing season available habitat (acres) and percent of total potential habitat based on Lake Tahoe elevations

Hydrologic condition	Month	Current conditions		No Action		LWSA		TROA	
		Acres	Percent Habitat	Acres	Percent Habitat	Acres	Percent Habitat	Acres	Percent Habitat
Dry	May	1620	59	1629	59	1630	59	1641	60
	June	1593	58	1604	58	1605	58	1615	59
	July	1642	60	1657	60	1658	60	1674	61
	August	1728	63	1740	63	1741	63	1753	64
	September	1822	66	1833	67	1834	67	1838	67
	Average	1681	61	1693	61	1694	61	1704	62
Median	May	220	8	222	8	222	8	213	8
	June	112	4	122	4	123	4	113	4
	July	158	6	166	6	167	6	160	6
	August	250	9	280	11	282	11	268	10
	September	569	21	592	22	594	22	525	19
	Average	262	10	276	10	278	10	256	10
Wet	May	17	1	20	1	20	1	14	1
	June	0	0	0	0	0	0	0	0
	July	0	0	0	0	0	0	0	0
	August	63	2	63	2	63	2	65	2
	September	134	5	135	5	135	5	139	5
	Average	42	2	44	2	44	2	44	2

There are 12 to 20 acres more available habitat in dry hydrologic conditions (an average of 13 acres more) under LWSA than under current conditions. In median hydrologic conditions, 2 to 32 acres more are available (an average of 16 acres more). Only slightly more habitat is available in May and September in wet hydrologic conditions under LWSA than under current conditions. The maximum difference, in terms of total potential habitat, is about 2 percent in August in median hydrologic conditions.

Soil saturation/inundation would be no greater under LWSA, and the existing population of Tahoe yellow cress would not be significantly affected by the small differences in available habitat under LWSA compared to either No Action or current conditions.

3. TROA

About 5 to 14 acres more shore zone habitat are available in dry hydrologic conditions (average of 11 acres more) and 6 to 67 fewer acres in median hydrologic conditions (average of 20 acres or less than 1 percent of the total potential habitat) under TROA than under No Action. In wet hydrologic conditions, 6 fewer acres are available in May, 2 to 4 acres more are available in August and September, and the same acres are available in June and July under TROA as under No Action. On average, 2 acres more are available under TROA than under No Action in wet hydrologic conditions.

About 16 to 32 acres more shore zone habitat are available in dry hydrologic conditions (average of 23 acres more) and 1 to 18 acres more are available in median hydrologic conditions under TROA than under current conditions, except in September, when 44 fewer acres are available. On average, 6 acres fewer are available under TROA than under current conditions, a difference of less than 1 percent of the total potential habitat. In wet hydrologic conditions, 3 fewer acres are available in May; 2 to 5 acres more are available in August and September, and the same acres are available in June and July. On average, 2 acres more are available under TROA than under current conditions in wet hydrologic conditions.

Soil saturation/inundation would not be greater under TROA. The greatest difference in available habitat occurs in September in median hydrologic conditions, when operations model results show 67 fewer acres under TROA than under No Action. The existing population of Tahoe yellow cress would not be significantly affected by the small differences in available habitat under TROA compared to either No Action or current conditions.

G. Mitigation and Enhancement

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

ISLAND NESTING WATER BIRDS

I. Affected Environment

Anaho Island at Pyramid Lake supports one of the largest breeding colonies of American white pelicans (a California Species of Special Concern) in western North America (Bell and Withers, 2002). The number of nesting colonies in the western United States has declined from 23 to fewer than 10 (Ehrlich et al., 1992). Over the past 25 years, the number of breeding adult pelicans has fluctuated between about 3,000 to more than 21,000. The most recent high of 17,000 breeding adults occurred in 1999. In 2003, there were about 5,000 breeding adults (Withers, 2004). Recent satellite and conventional telemetry studies have shown that individual birds from Pyramid Lake commonly travel throughout northern Nevada and to the Central Valley of California; individuals have been tracked as far east as the Great Salt Lake in Utah and as far south as the states of Guanajuato and Michoacan in central Mexico (Yates, 1999).

There is no estimate of the current American white pelican population. Although the species was in a long-term historical decline until the 1960s, populations have increased through the 1980s (Evans and Knopf, 1993). Based on the North American Breeding Bird Survey, the population trend in the Basin and Range from 1966-2001, where the study area is located, is negative (-9.6 percent per year). These data are acknowledged to have important deficiencies because of the low regional abundance of birds, few survey routes, low precision, and inconsistencies in trend over time (Sauer et al., 2003). The Great Basin as a whole is estimated to support 18 percent of the world's breeding American white pelicans (Carter et al., 1996, as cited in Neel, 1999). The Nevada Partners in Flight Bird Conservation Plan has set an objective of maintaining an average of 4,500 nesting pairs of pelicans at Anaho Island through 2004. This number is based on the yearly averages in the 1980s and 1990s (Neel, 1999). There is presently no access by terrestrial mammalian predators, such as coyotes, to Anaho Island because of the depth of water and distance of the mainland.

Pelicans begin to arrive at Anaho Island the second or third week of March and begin to build nests and lay eggs about the second week of April (Woodbury, 1966). Cui-ui is an important food source for adult pelicans and provide a substantial food source during the early part of the nesting season when there is a cui-ui spawning run (Scoppettone and Rissler, 2002; Scoppettone, 2003). Cui-ui runs occur in higher water years and counts of white pelican adults, nests, and chicks at Anaho Island are strongly correlated with springtime flows (Murphy and Tracy, 2002). When cui-ui ascends the Truckee River in April or May to spawn, they are heavily preyed upon by pelicans.

Primary foods of young pelicans are carp and tui chub. Tui chub is an abundant fish indigenous to Pyramid Lake, and carp is found in nearby wetlands, such as Humboldt Sink, Stillwater Marshes, and Carson Lake (Knopf and Kennedy, 1980). No data are available on the density, availability, or relative proportion of other prey used by pelicans. However, pelicans are opportunistic feeders and will travel great distances to forage on seasonally available fish (Bell and Withers, 2002). Maintaining wetlands and their fish biomass within approximately 62 miles of nesting islands is essential to the continued success of the nesting colony (Knopf and Kennedy, 1980).

California gull nests at Anaho Island in Pyramid Lake and on islands in Lahontan Reservoir. It is currently considered a third priority species, which means that it is not in any present danger of extirpation and its populations within most of its California range do not appear to be in serious decline (CDFG, 2004). The current list is undergoing review: a review draft indicates that California gull does not meet the criteria for inclusion on the new Bird Species of Special Concern List. There is no identified conservation concerns for this species in Nevada at the present time.

The current population of California gull likely contains between 500,000 and 1 million individuals, a number that is likely larger than it was soon after the turn of the nineteenth century (Winkler, 1996). Based on the North American Breeding Bird Survey, the population trend in the Basin and Range from 1966-2001 shows an increase of 3.2 percent per year. Because of the highly colonial nature of the California gull, estimates based on transects (such as the Breeding Bird Survey) are not likely to provide a very accurate picture of bird abundance (Winkler, 1996).

Since 1950, the number of California gull nests on Anaho Island has ranged from1,000 to 3,300 (FWS, 1990). There are approximately 3,000 pairs of California gulls in colonies on islands in Lahontan Reservoir (Yochem et al., 1991). The California gull colony at Lahontan Reservoir is the largest of the few colonies in Nevada (Yochem et al., 1991); it is not known whether gulls from this colony move to other colonies in California or elsewhere to breed. Both food supply and a nesting sanctuary are key factors in the nesting success of this species (Gaines, 1988).

In other locations, there is limited genetic exchange between isolated colonies. California gull population structures typically are islands that experience some genetic exchange through breeding individuals that disperse among populations (Pugesek, 1996). There are no data on the importance of individual colonies to the species as a whole (Shuford, 1996) or how many individual colonies are necessary to maintain a level of genetic exchange to ensure genetic viability. Like most California gull colonies, the Lahontan Reservoir population is relatively small; of the 206 known breeding colonies only nine supported more than 20,000 birds (Winkler, 1996). The genetic influence of the Lahontan population on the total California gull population, therefore, may be small (Winkler, 1996).

California gulls were first documented nesting on islands in Lahontan Reservoir in 1939 (Alcorn, 1988). Since then, lake elevation data show that the main nesting island (Gull Island) has been landbridged in 26 percent of the years during the gull nesting season and the smaller island (Evans Island), which has a small population of California gulls and other species, has been landbridged in 7 percent of the years from 1939 to 1996. The stability of the population of California gulls at Lahontan Reservoir is unknown (Yochem et al., 1991).

It is also not known what effect historic predation has had on the population of gulls and other colonial nesting species at Lahontan Reservoir; however, colonial species have continued to use these islands over time despite past land bridging.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

Two indicators were selected to evaluate effects on island nesting birds:

1. American white pelican prey availability (based on two indicators from the cui-ui analysis: average annual inflow to Pyramid Lake and the frequency that flow regime 1, 2, or 3 is achieved in the lower Truckee River from April through June).

2. Predator access to California gull nesting islands in Lahontan Reservoir.

B. Summary of Effects

The summary of effects on American white pelican prey availability is the same as discussed in "Cui-ui" for the indicators of average annual inflow to Pyramid Lake and the frequency that flow regime 1, 2, or 3 is achieved in the lower Truckee River from April through June.

Operations model results show that mainland predators could access California gull nests on islands in Lahontan Reservoir 1-2 percent more frequently under TROA than under current conditions and the same or 1 percent more frequently than under No Action (or LWSA). There would be no effect on California gull nesting.

C. American White Pelican Prey Availability

See "Cui-ui" for discussions of methods of analysis, thresholds of significance, model results, evaluations of effects, and mitigation and enhancement.

D. Predator Access to California Gull Nesting Islands in Lahontan Reservoir

See "Waterbirds and Shorebirds" for discussions of method of analysis, model results, and evaluation of effects.

1. Threshold of Significance

No scientific data exist to support an absolute numeric threshold for the frequency of predator access that would constitute a significant adverse effect. A significant adverse effect on the population of California gulls at Lahontan Reservoir would occur if predation caused it to decline below a self-sustaining level (this level is unknown)or if the colony were abandoned and the gulls were not able to establish a new colony or breed elsewhere. If gulls abandoned Gull Island, they may move to Evans Island or to other historic nesting sites in the Carson Sink or Stillwater National Wildlife Refuge if appropriate conditions (high water) were to exist (Neel, 1997). In other locations, when adults abandon a colony as a result of predation, it is not known where they go or if they breed elsewhere (Shuford, 1996).

Landbridging has occurred in the past at Lahontan Reservoir, and California gulls continue to breed successfully at this site. The determination of significance, therefore, was based on best professional judgment. Based on information presented above, any adverse effects on the Lahontan Reservoir population would be a local effect and would not have a significant adverse impact on California populations or on the species as a whole.

2. Mitigation and Enhancement

Operations model results show that the elevation of Pyramid Lake never falls below the threshold under current conditions and the alternatives. Predator access to islands in Lahontan Reservoir where California gulls nest occurs slightly more frequently under TROA, but the difference is too small to constitute a significant adverse effect. No mitigation, therefore, would be required.

OSPREY

I. AFFECTED ENVIRONMENT

Osprey are known to nest at Stampede Reservoir and Lake Tahoe. This species also is known to nest along the Little Truckee River. In the California portion of the study area there may be other pairs of nesting osprey, but the sites have yet to be documented (Jurek, 2003).

II. ENVIRONMENTAL CONSEQUENCES

Live fish comprise at least 99 percent of osprey prey items (Poole et al., 2002). A wide variety of fish species are taken but often only two or three species account for the majority of prey taken in any one area. Inland osprey forage along rivers, mashes, reservoirs, and natural ponds and lakes, in both shallow and deep water. Reservoirs often provide ample expanses of shallow, clear water that provide ideal conditions for hunting. Nesting densities also show a preference for shallow water. Periods of low water can lead to reduced prey availability due to the prolific growth of aquatic vegetation (Poole et al., 2002) Effects on osprey were, therefore, based on analyses of the effects on the primary prey base of osprey, live fish in lakes and reservoirs, the same indicator as for bald eagle. See “Bald Eagle” for discussions of summary of effects, method of analysis, threshold of significance, model results, evaluation of effects, and mitigation and enhancement.

HABITAT FOR OTHER SPECIAL STATUS PLANTS

I. AFFECTED ENVIRONMENT

In addition to Tahoe yellow cress, eight plants, one lichen, and two mosses may occur in the study area and could potentially be affected by modified operations of Truckee River reservoirs. These plant species and their habitats are discussed below.

A total of 32 other special status plants known or likely to occur within the study area were evaluated. Most occur in upland habitats or other non-riparian/riverine habitats that would not be affected by the alternatives. A list of these species is included in the Biological Resources Appendix.

Shore sedge, on CNPS List 2, is rare in California but has a widespread, patchy, distribution elsewhere in western North America. It is typically associated with sphagnum but may also be found along lake, pond, and small stream margins. It is unlikely to occur along the mainstem of the Truckee River, but could potentially be found along the upper tributaries. It is know to occur in the Sagehen Creek drainage, upstream of Stampede Reservoir (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

Grants Pass willowherb, on CNPS List 1B, is also rare in California where is primarily found in the Klamath Mountains. It is also known from the adjacent Siskiyou Mountain in Oregon, where it is considered rare. Like the shore sedge, it typically is found with sphagnum but may also be found along small streams. It is known to occur in the Sagehen Creek drainage, upstream of Stampede Reservoir (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

American manna grass, on CNPS List 2, is extremely rare in California which lies along the southern edge of this more northerly species' range. Its typical habitats include meadows, lakes, and stream margins. Within the study area, it has been documented from the vicinity of Squaw Creek near the Truckee River (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

Marsh skullcap, on CNPS List 2, is a circumboreal species which is rare in California. It may be found in wet meadows and along streambanks. It was collected in 1884 near Truckee and is known to occur in the Lake Tahoe basin (CalFlora, 2004; CNPS, 2003; Holst and Ferguson, 2000; Hickman, 1993).

Plumas ivesia, on CNPS List 1B, occurs only in a few northern Sierra counties where it may occur in wetlands. Within the study area, there are numerous known locations in the Sagehen Creek drainage upstream of Stampede Reservoir and in Martis Valley east of Truckee (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

Slender leaved pondweed, on CNPS List 2, always occurs in wetlands typically in shallow, freshwater marshes and lakes. It is a circumboreal species that is rare in California. It was collected in 1931 from Lake Tahoe; it is also documented from Sierra County (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

White-stemmed pondweed, on CNPS List 2, always occurs in wetlands, typically in deep water and lakes. It is a circumboreal species that is rare in California. Although it has not been reported from the study area, it is documented from adjacent Sierra County (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

Water bulrush, on CNPS List 2, is known from lake margins and water edges. It is a more northerly species which reaches the southern limit of its distribution in California. It is not known from the study area but has been documented from the Lake Tahoe basin (CalFlora, 2004; CNPS, 2003; Hickman, 1993).

The veined water lichen, a USFS Sensitive Species, is a freshwater lichen that ranges from the Sierra Nevada north to Alaska. It grows in clear, mid- to high-elevation streams where water quality appears to be very good. This aquatic lichen grows primarily on small to medium rocks or bedrock and occasionally on wood, or partially buried in loose gravel (Derr, 2000). Within California, it is known from only a few streams from Calaveras County south to Tulare County (Shevock, 1996).

The three-ranked hump-moss, a USFS Sensitive Species and California Species of Special Concern, and the broad-nerved hump-moss, a Forest Service Sensitive Species, are aquatic mosses. Both are on CNPS List 2 and occur in meadows and seeps and other wetland habitats in the Sierra Nevada. The three-ranked hump-moss is known to occur in the Sagehen Creek drainage upstream of Stampede Reservoir. The broad-nerved hump-moss has not been documented to occur in the study area (CNPS, 2003).

II. Environmental Consequences

The relation between riparian-associated and aquatic special status plant species and their habitats has been described. As with other riparian plants, changes in riparian habitat can be used to assess the probable effects of the various scenarios on special animal species. Moreover, since the effects on riparian habitats are based on average monthly flows, the same analysis can be used for special status aquatic plant species. A single indicator, therefore, was chosen for other special status plant species: relative amounts of riparian habitat. See “Riparian Habitats and Riparian-Associated Wildlife” for discussions of summary of effects, method of analysis, threshold of significance, model results, evaluation of effects, and mitigation and enhancement.

HABITAT FOR OTHER SPECIAL STATUS ANIMAL SPECIES

I. AFFECTED ENVIRONMENT

In addition to the individual animal species previously discussed, 12 other species of mammals, birds, fishes, invertebrates, amphibians, and reptiles listed by either the State of California or Nevada, or otherwise accorded special status occur within the study area and could potentially be affected by modifying operations of Truckee River reservoir. These species are discussed by their habitat relationships as follows.

An additional 37 species of mammals, birds, and invertebrates known or likely to occur within the study area were evaluated. Most occur in upland habitats or other non-riparian/riverine habitats that will not be affected by the alternatives under consideration. A list of these species is included in the Biological Resources Appendix.

A. Palustrine Emergent Wetlands

Four special status species have a primary association with emergent wetlands within the study area: northern leopard frog, northwestern pond turtle, northern harrier, and long-billed curlew.

The distribution of northern leopard frog, a Forest Service Sensitive Species, appears to have been severely reduced along the Truckee River and now occurs along a reach of the lower river approximately 10 miles upstream of Pyramid Lake (Panik, 1992; Panik and Barrett, 1994; Ammon, 2002b). Breeding habitat is described as off channel wetlands such as oxbows, spring heads and, spring outflows (Ammon, 2002b). Breeding has been documented along the lower Truckee River in permanent wetland areas, but the population is considered extremely small and vulnerable to extinction (Ammon, 2002b). Northern leopard frogs use many different habitat types along this section of river; therefore, it is critical that all riparian habitat types are protected and that the river and riparian areas function properly for this species to survive. Non-native bullfrogs are found throughout this same section of the Truckee River and pose a considerable threat to the continued existence of northern leopard frog (Panik and Barrett, 1994; Ammon, 2002b).

Northwestern pond turtle, a USFS Sensitive Species, occurs in Nevada mostly along the Carson River, although some individuals may persist in a few sites along the Truckee River (Jennings et al., 1992). The species inhabits rivers, tributaries, ponds, lakes, marshes, oxbows, and other seasonal and permanent wetlands (Stebbins, 1985; Reese and Welsh 1998). Channelization of streams and rivers reduces or eliminates critical habitat such as slow, deep pools with large woody debris and stable undercut banks (Reese, 1996). Introduced species are the primary predators on juvenile turtles (Reese 1996; Hays et al. 1999). Bullfrogs have been reported as preying on juvenile turtles (Hays et al. 1999) and are considered a primary threat to juvenile survival and population recruitment (Ammon 2002b). Eggs, juveniles, and adults on land also face a myriad of predators including raccoon, coyote, red fox, and ravens (Ammon, 2002b). Females may leave the riparian corridor to excavate a nest site in uplands, and individuals overwinter away from watercourses in upland areas (Jennings et al., 1992; Reese, 1996). The relative amount of palustrine emergent wetlands and affected pond-like areas is an indicator of how changes in flows may affect this species.

Northern harrier, a California Species of Special Concern, has greatly declined as a breeding bird in California where it is now considered a permanent resident only of the northeastern plateaus, coastal areas, and the Central Valley. Although it is known to breed at up to elevation 5,700 feet in the Sierra Nevada, it does not frequent forested areas. It was not observed during surveys along the Truckee River and its tributaries (Lynn et al., 1998). Northern harrier is a common permanent resident at many locales throughout the Great Basin. In both California and the Great Basin, it is most often associated with marshes and agricultural areas (CPIF, 2000; NDOW, 1985; Ryser, 1985). It is frequently observed during Christmas bird counts in the Truckee Meadows and Pyramid Lake areas (Clark, 1998; Eidel and Clark, 1999; Floyd and Eidel, 2000).

Long-billed curlew, a California Species of Special Concern and FWS Bird of Conservation Concern, is not known from the study area in California but is a migrant and known to breed in the Great Basin of Nevada where it has been declining as a result of agricultural and other land development (Ryser, 1985). It was observed infrequently during surveys along the lower Truckee River (Lynn et al., 1998), and was recorded as common in 1868 (Klebenow and Oakleaf, 1984). Long-billed curlew prefers closely cropped grasslands, pastures, wet meadows, and dry meadows (usually associated with water), either on the fringe of a marsh, in a meadow, or on a broad floodplain (Neel, 1999).

B. Palustrine Scrub-Shrub Wetlands

Four special status animal species are known to be closely associated with scrub-shrub wetlands within the study area: willow flycatcher, yellow warbler, yellow-breasted chat, and Nevada viceroy.

Willow flycatcher, a California Endangered species and a USFS Sensitive Species, is associated primarily with montane riparian habitats. The species has declined in California and, although breeding populations remain in a few strongholds in the Sierra Nevada, in recent surveys, 53 of 135 known sites were found to no longer support willow flycatchers. Willow flycatcher in the Sierra Nevada is considered a population in peril (Green et al., 2003). Within the study area, only two of the seven known breeding sites in the Lake Tahoe Basin Management Unit were active, a decline of 71 percent; in the Tahoe National Forest, the number of active sites has declined from 18 to 14, or 22 percent. Willow flycatchers occur along the Little Truckee River where suitable habitat occurs in broad, flat meadows that are generally larger than 19.8 acres, contain free water, and have 50-70 percent cover of patchy willow thickets at least 6.6 feet tall (Sanders and Flett, 1989). They are also known to occur southwest of Independence Lake (Serena, 1982), and along the Upper Truckee River (Lynn et al., 1998). Although the range of the willow flycatcher is known to extend eastward into the Great Basin of Nevada, its status there is poorly understood (Neel, 1999). The most recent records from the lower Truckee River are museum specimens taken from the Reno area in the late 1960s (Alcorn, 1988). Direct threats to the species in the Sierra Nevada include poor meadow conditions that increase erosion and brown cowbird parasitism, water diversion, recreation, and roads (Green et al., 2003).

Yellow warbler, a California Species of Special Concern, is declining over much of the United States, especially in the West, and particularly in California and Arizona (Ehrlich et al., 1992). California populations are much reduced and have been extirpated in some areas (Remsen, 1978). In the early 1990s, yellow warblers were found in all reaches of the Truckee River in relatively high numbers (Lynn et al., 1998) and they remained common along the lower Truckee River through 2001 (Ammon, 2002a). Optimal nesting habitat is provided in wet areas with dense (60 to 80 percent) crown cover and moderately tall (6.6 feet or greater) stands of willow and alder of at least 0.37 acre (Schroeder, 1982).

Yellow-breasted chat, a California Species of Special Concern, was once a common summer resident in riparian woodlands throughout the State, but is now much reduced in numbers. It nests in riparian scrub and cottonwood-willow habitats and was observed along the lower Truckee River in small numbers in the early 1990s (Lynn et al., 1998). It was not seen along the upper Truckee River or its tributaries during these surveys. During surveys in 1998 and 2001 it was reported as common along the lower Truckee River, attributed to a substantial increase in early successional riparian shrublands (Ammon, 2002a).

Nevada viceroy, considered critically imperiled in Nevada, is a butterfly known only from Nevada where it is found primarily along the Humboldt River. Additional colonies are known in the study area near Fallon and Fernley. It occurs only in the immediate vicinity of willows the larvae host plant (Austin, 1990).

C. Palustrine Forested Wetlands

One special status species, Swainson’s hawk, is associated with riparian forests. It is a State of California Threatened species and FWS Bird of Conservation Concern. Once found throughout the Central Valley (but absent from the Sierra Nevada), today it is restricted to portions of the Central Valley and the Owens Valley in the Great Basin (CDFG, 2000). In Nevada, Swainson’s hawk is a resident from April through October. Although it was described in 1877 to be “one of the most abundant of the large hawks of the interior” (Ridgway, 1877), a decline of 20.4 percent was identified by the Breeding Bird Survey in the Basin and Range Province from 1966 to 1979.

Since 1980, the population has shown an increasing trend of about 3.8 percent. In Nevada, Swainson’s hawks reside in agricultural valleys interspersed with cottonwood trees or on river floodplains with cottonwood trees (Neel, 1999). Swainson’s hawks have not been observed during recent surveys along the Truckee River (Lynn et al., 1998).

D. General Riparian or Aquatic Habitats

Aquatic special status species occurring within the study area and potentially affected by changes in reservoir operations include a fish, mountain sucker, and three aquatic invertebrates: California floater, Great Basin rams-horn, and a moth.

Mountain sucker, a California Species of Special Concern, has a wide distribution in the western United States although the population within the Truckee River has long been isolated from all others. It typically inhabits clear streams with moderate gradients; 10-50 feet wide and less than 6 feet deep; with rubble, sand, or boulder bottoms. It also can live in large rivers and turbid streams. Although found in lakes and reservoirs, it is absent from Lake Tahoe and Pyramid Lake. It does not persist in reservoirs, which usually flood habitat and isolate populations. In California, only small populations susceptible to extirpation remain. Within the study area in Nevada, high densities of mountain sucker may exist in the Truckee River upstream from Reno (Moyle, 2002).

California floater, a freshwater mollusk, is considered critically imperiled in Nevada. It occurs in lakes and fairly large streams or slow rivers. It is generally found on soft substrates such as mud or sand (Frest and Johannes, 1995). The original distribution included the Pacific Northwest, south to the northern San Joaquin Valley of California. It has apparently been extirpated from Utah and has a very limited distribution in Arizona. In the 1880s, California floater was found sparingly in the Truckee River (Call, 1884). It is clearly declining in numbers and in area occupied throughout its range.

Great Basin rams-horn, also a freshwater mollusk, occurs in larger lakes and slow rivers including springs and spring-fed creeks, usually in areas with soft substrates and clear, very cold, slowly flowing water (Frest and Johannes, 1995). The species historically occupied 14 widely distributed sites throughout the western United States; few sites survive. Within the study area, it has been reported from Lake Tahoe and the adjacent slow segment of the Truckee River (Taylor 1981, as cited in Frest and Johannes, 1995).

The aquatic moth, *Petrophila confusalis*, considered critically imperiled in Nevada, is a widespread western North American species found in well-oxygenated water of streams and lakes. The adult female usually deposits eggs on the underside of rocks. In northern California, two to three generations of this species occur a year (Lange, 1984). Larvae are most abundant in lakes and streams where the water velocity is between 0.4 and 1.4 meters per second (Tuskes, 1981 as cited in Lange, 1984). They are generally shredders-herbivores that feed on aquatic plants. This species was identified in a recent during a recent study of the invertebrate communities of Pyramid Lake (Alexandrova, 2003).

Riparian habitat sustains four species of bat: pallid bat, pale Townsend’s big-eared bat, western red bat, and the fringed myotis. The first two are USFS Sensitive Species and California Species of Special Concern. Pallid bat is unusual in that it feeds almost entirely on prey captured on the ground; it may on occasion roost in tree cavities, including cottonwoods. Pale Townsend’s bat may forage in riparian areas. Western red bat, a USFS Sensitive Species, roosts only in tree foliage and is closely associated with lowland riparian forest in arid areas. Fringed myotis, considered imperiled in Nevada, is typically a woodland species at middle elevations in the mountains, but may also be found in more arid environments.

II. Environmental Consequences

The relation between riparian-associated and aquatic special status animal species and their habitats has been described above. As with other animal species, changes in riparian habitat can be used to assess the probable effects of the various scenarios on special animal species. Moreover, since the effects on riparian habitats are based on average monthly flows, the same analysis can be used for special status aquatic animals. A single indicator, relative amounts of riparian habitat, therefore, was chosen for special status animal species. See "Riparian Habitats and Riparian-Associated Wildlife" for discussions of summary of effects, method of analysis, threshold of significance, model results, and evaluation of effects. Because of the benefits and enhanced environmental conditions under TROA, no mitigation would be required. Riparian habitat for riparian-associated and aquatic special status animal species would be enhanced under TROA.

RECREATION

I. AFFECTED ENVIRONMENT

A. Introduction

Streams, lakes, and reservoirs within the study area provide a valuable water resource that helps support two of the most important recreation activities in America: boating (rafting, kayaking, canoeing, and flat water power craft) and fishing. Streams, lakes, and reservoirs also support other popular water-based activities, including swimming, sightseeing, tubing, and camping (which occurs primarily near the water).

The Truckee River and its tributaries and nearby reservoirs service the recreation needs of one of the fastest growing population centers in the United States—the Tahoe, Truckee, and Truckee Meadows areas (Auckerman, et al., 1999). Recreation settings and activities associated with water bodies throughout the study area are accessible, affordable, and diverse.

The numerous recreational resources and opportunities in the study area range from forested mountains in California to arid deserts in Nevada. The California portion of the study area is characterized by high country rivers, reservoirs and natural lakes, and outstanding scenery. The Nevada portion of the study area is characterized mainly by high desert terrain, riverine vegetation, rivers, Pyramid Lake, reservoirs, and wildlife areas.

The gaming industry in Nevada, combined with the setting and recreational opportunities, makes the study area a primary destination for tourists. Recreationists are drawn mostly from the San Francisco Bay area, Sacramento, and Reno. Since 1960, the Squaw Valley Olympic site has attracted visitors from all over the world for skiing during the winter and unique ski area activities during the summer.

The water-based recreation season considered in this analysis is the 7-month period from April through October, when recreationists are most likely to use the Truckee River and its associated reservoirs and lakes. Other months of the year are cold and snowy, deterring many visitors, except skiers and snowboarders.

Table 3.71 presents recreation activity participation rates that reflect interview research completed in August 1995 and updated in 1999 by the University of Nevada, Reno (UNR) for BOR. These data are the most recent detailed data available. The 1995 interviews were conducted in the final years of a drought; therefore, participation rates could be somewhat low. Table 3.71 also compares the recreation activity participation rates in the Truckee River basin to those of Californians in general (derived from the California State Comprehensive Outdoor Recreation Plan [SCORP]). The survey showed 3.37 activities per person per day, confirming the diversity of activity interest. Camping, fishing, water skiing, and “other activities” had high participation rates.

Table 3.71.—Recreation activity participation at lakes and reservoirs in the Truckee River basin (percent of population)

Recreation activity	California SCORP	Truckee River basin interviews by UNR
Picnicking	64	31
Camping	46	65
Fishing	37	57
Swimming	59	34
Boating	20	19
Fishing from boat	No data	33
Water skiing	14	28
Jet skiing	No data	15
Rafting	No data	7
Kayaking	15	3
Biking	23	15
Other activities	No data	30

Table 3.71a (also a result of UNR interview research) presents repeat visitation at lakes and reservoirs in the Truckee River basin in 1993 and 1994. The amount of repeat visitation indicates that visitors are satisfied with the recreation experiences associated with the recreation resources, facilities, and opportunities at lakes and reservoirs in the Truckee River basin. Table 3.71a also displays percentages of visitors who made repeat visits. The number of visits represents how many times the interviewees visited each reservoir during the year.

Table 3.71a.—Repeat visitation at lakes and reservoirs in the Truckee River basin

Lake/reservoir	1993		1994	
	Percent of repeats	Number of visits	Percent of repeats	Number of visits
Donner	No data	No data	46	5
Prosser Creek	19	8	16	6
Stampede	53	4	37	4
Boca	49	11	26	6
Pyramid	28	8	36	10

B. Recreation Facilities

Recreation at Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs could be affected by modifying operations of Truckee River reservoirs. Although the proposed action could affect Lake Tahoe and Independence Lake, effects to recreation would be minimal. Recreation at smaller facilities, such as Webber Lake and Martis Creek Reservoir, is not analyzed.

1. Lakes and Reservoirs

a. Lake Tahoe

A wide variety of recreational activities occur on Lake Tahoe's 122,200 water surface acres and along its 71 miles of shoreline. Adjacent recreation lands and facilities are primarily owned and managed by USFS, California and Nevada, local entities, such as North Tahoe and Tahoe City Public Utility Departments, and South Lake Tahoe Intermingled with the government-operated areas are privately-owned and operated campgrounds, marinas, golf courses, hotels, restaurants, casinos, and numerous resorts and other commercial businesses.

Lake Tahoe is a primary destination spot for visitors from all over the United States and offers year-round recreation opportunities. Visitation is greatest during the summer recreation season (June, July, and August); however, the 25 ski resorts in the area and the casinos attract a large number of visitors through the winter season. The primary recreation activities are sailing, boating, gambling, water skiing, camping, scuba diving, windsurfing, swimming, sightseeing, hiking, photography, and fishing for mackinaw, kokanee, rainbow trout, and brown trout.

The visual quality of Lake Tahoe is considered outstanding, especially in light of the amount of commercial development on adjacent lands and along the lakeshore. The large oval-shaped basin and lake, rugged shoreline, and dense pine forests offer enough absorptive characteristics to lessen the effects of development and visitor use on the surrounding landscape.

b. Donner Lake

Donner Lake is located on Donner Creek. Donner Lake Dam, near the western edge of Truckee, California, was originally constructed in 1877 at the natural lake's outlet and rebuilt in 1933. Today, the dam site is surrounded by Donner Memorial State Park. Recreation facilities are owned by California Department of Parks and Recreation, Truckee-Donner Recreation and Park District, Tahoe-Donner Homeowners' Association, Donner Lake Homeowners' Association, and individual private landowners.

Truckee-Donner Recreation and Park District is responsible for operating and maintaining several facilities at Donner Lake, including two beaches, 36 piers, and the only public boat launch ramp. Tahoe-Donner Homeowners' Association maintains a beach and boat launch facility at the east end of Donner Lake. Donner Lake Homeowners' Association maintains 330 feet of lakefront and two private piers on the north side of Donner Lake.

Numerous second homes and condominiums are located around the shoreline. During the summer and winter, many residences are rented for family vacations. Most visitors are from the San Francisco Bay and Sacramento areas. The aesthetic qualities include views of the lake and mountains, the shade and scent provided by the mature trees, and the relative serenity.

Donner Lake visitation is as follows:

- Truckee-Donner Recreation and Park District (1999): about 77,600 visits between Memorial Day and Labor Day. Total estimate, April through October: 108,640.

- Tahoe-Donner Homeowners' Association, east end of lake (1988-93): annual summer usage varied from 16,680 to 26,456 people.

- Donner Lake Homeowners' Association: average annual attendance of 40,000 people.

- Donner Tract Homeowners' Association, north side of lake: no visitation records available.

- Donner Memorial State Park: 200,000 visitors annually.

The ideal elevation at Donner Lake is 5935 feet msl. At this elevation, public and private facilities are fully usable. The 36 piers are used by swimmers, fishermen, and boaters. However, at elevation 5934 feet, use of many of the facilities becomes marginal. In particular, the boat launch ramps at Tahoe-Donner Homeowners' Association facilities and Donner Lake Homeowners' Association facility are barely usable below elevation 5934 feet. Safety becomes a concern at the public piers because the water is shallow. At elevation 5933 feet, only the public ramp is usable; all other boat ramps and piers are unusable.

The 1943 Donner Lake Indenture directs that Donner Lake not fall below elevation 5932 feet during June, July, and August, except to meet minimum streamflow requirements. (See chapter 2.) Additionally, dam safety requirements specify that the discharge gates of the dam be held open from November 15 through April 15 to prevent it from exceeding elevation 5926.9 feet. Drawdowns may occur in September and October in anticipation of opening the discharge gates to meet this requirement. The maximum elevation of Donner Lake is 5940 feet.

c. Prosser Creek Reservoir

Prosser Creek Dam and Reservoir, completed in 1962, are located on Prosser Creek 1.5 miles upstream of its confluence with the Truckee River. USFS manages and operates recreation facilities at the reservoir. The project has 2,070 acres of land, 748 surface acres of water, and 12 miles of shoreline.

Recreation facilities include three boat launch ramps with two lanes each, eight toilets, and three campgrounds, with a total of 46 campsites. There are no concession facilities or cabins on the project lands. USFS collects $12-per-night user fees for the campsites through a private campground concessionaire.

The most popular recreation activities are fishing, motor boating, and picnicking. During the fall, hunting for mule deer, geese, and ducks is popular. CDFG stocks kokanee and rainbow and brown trout in the reservoir.

Prosser Creek Reservoir is the smallest of the three reservoirs in the upper Truckee River basin. It is more appropriate for recreation use by small, slow watercraft. Local officials enforce several restrictions, including a 10-mile-per-hour speed limit and a boat movement traffic pattern. The reservoir's physical characteristics and management make it popular for fishing, paddle boating, canoeing, and water play. There are no designated swimming areas, but visitors wade and swim. The reduced speed and traffic patterns reduce conflicts among the activities. The reservoir is also conducive to passive uses on the water and shoreline. Nearby residents enjoy taking walks to and around the reservoir.

No recent site-specific recreation visitation data are available for Prosser Creek, Stampede, or Boca Reservoirs. In 1995, USFS changed its visitor use reporting system at the direction of Congress. Recreation visitation reported since that time using the newly established system is on a forest-wide basis with limited site-specific information.

When the reservoir elevation is 5724 feet (548 surface acres) or greater, use of the boat launch ramps is unimpaired. When the elevation is less than 5724 feet, the ramps become less usable, and the following changes occur:

- Larger boats have limited access to the water. If boats are launched in areas without a ramp or off the old Highway 89 roadbed, the vehicle, trailer, or boat may get stuck in the mud.

- Aesthetics of the reservoir and USFS campground decline due to the "bathtub ring" effect.

- Visitors must travel greater distances from the water to the toilet facilities.

- Conditions for stocking fish in the reservoir are marginal.

d. Stampede Reservoir

Stampede Dam and Reservoir, completed in 1970, are located on the Little Truckee River 8 miles upstream of its confluence with the Truckee River. USFS manages and operates recreation facilities at the reservoir. The project has 10,740 acres of land, 3,452 surface acres of water when full, and 29 miles of shoreline.

Recreation facilities include one picnic area with four tables, one boat launch ramp with three lanes, 20 toilets, and seven campgrounds, with a total of 256 campsites; and three group camp facilities that accommodate 150 people. USFS collects $15-per-night user fees for the campsites through a campground concessionaire.

The most popular recreation activities during the summer are fishing, camping, and motor boating. During the fall, hunting for mule deer, geese, and ducks is popular. CDFG stocks kokanee and lake, rainbow, and brown trout.

Stampede Reservoir is the largest reservoir in the Truckee River basin. It is about a 20-minute drive beyond Boca Reservoir, which makes it slightly less accessible to visitors traveling the main roads in the area.

Stampede Reservoir boat launch ramps provide unimpeded access to the water when the elevation is 5881 feet (1,475 surface acres) or higher. When the elevation is less than 5881 feet and the boat ramps are less usable, the following changes in recreation occur:

- Number of boats launched decreases.
- There is a substantial walk from the water to parking facilities and toilet facilities.
- The campground is somewhat removed from the reservoir shoreline. Anglers tend to drive to and use different areas of the reservoir to avoid crossing the foreshore mudflats. Toilet facilities in the day use area are not close to the water, and visitors must walk up to one-half mile to them.
- Aesthetic qualities around the reservoir diminish. Odors from decaying vegetation, mudflats in the foreshore area, and turbidity in the water all occur. Turbidity reduces the quality of the fishing experience.
- The growth rate of kokanee is reduced, which reduces the quality of the fishing experience.

e. Boca Reservoir

Boca Dam and Reservoir, completed in 1939, are located on the Little Truckee River about 3 miles downstream from Stampede Dam and immediately upstream of the confluence of the Truckee River and the Little Truckee River. USFS manages and operates recreation facilities at the reservoir. The project has 3,052 acres of land, 887 surface acres of water, and 15 miles of shoreline.

Recreation facilities include one boat launch ramp with two lanes, five toilets, and two campgrounds, with a total of 59 campsites. USFS collects $12-per-night user fees for the campsites through a private campground operator.

The most popular recreation activities are fishing, camping, water skiing, windsurfing, and jet skiing. During the fall, hunting for mule deer, geese, and ducks is common. CDFG stocks kokanee and rainbow and brown trout.

Boca Reservoir boat launch ramps provide unimpeded access to the water when the elevation is 5591 feet (822 surface acres) or higher. When the elevation is less than 5591 feet, the following changes in recreation occur:

- Large watercraft use decreases.
- Shallow waters tend to be warmer, thus wader and swimmer visitation increase. Broad expansive mudflats, however, are not conducive to swimming
- After mud flats dry, off-road vehicles, dirt bikes, and mountain bikes use the reservoir's expanded shoreline
- Ski Jump Cove, where a ski club practices water skiing skills, cannot be used. The favorable water ski dropoffs and takeoffs are no longer useable.
- Noise is reduced because of fewer boat engines, but more reservoir foreshore is exposed, revealing mud flats and odors from decaying vegetation.

f. Lahontan Reservoir

Lahontan Dam and Reservoir, completed in 1915, are located on the Carson River. Nevada Division of Parks manages the water surface area, consisting of 12,100 acres at full pool; adjacent lands, consisting of 18,262 acres; and associated recreation facilities for recreation purposes. The reservoir has approximately 70 miles of shoreline. Seasonal entrance fees are collected at the two main access points located at Churchill Beach and Silver Springs Beach.

Lahontan Reservoir offers a number of facilities and opportunities to western Nevada residents, the primary users of the reservoir. Facilities include one developed campground with 27 sites, two boat ramps, six restrooms with flush toilets and showers, 12 vault toilets, 12 pit toilets, and three restrooms with flush toilets but no showers. The beach areas are open to public camping. The recreation season extends from April 1 to October 31. Recreation activities include boating, jet skiing, water skiing, camping, fishing, sightseeing, picnicking, hunting, and swimming. Fishing occurs primarily from boats. The warm water fishery supports walleye, white bass, catfish, largemouth bass, sunfish, and a cool water fish, rainbow trout. The reservoir holds the State record for walleye. Table 3.72 presents recreation visitation at Lahontan Reservoir from 1993-2002. Data are from Summary Statistical Data Sheets, Nevada Division of Parks.

The boat ramps provide unrestricted access to the water when the reservoir elevation is 4138 feet or higher. When the elevation is less than 4138 feet, the following changes in recreation use occur:

- Number of boats launched decreases, especially larger boats.

Table 3.72.—Recreation visitation at Lahontan Reservoir: 1993 - 2002

Year	Total recreation visitation (Number of visitors)
1993	356,844
1994	246,471
1995	460,222
1996	436,939
1997	385,750
1998	384,253
1999	383,493
2000	584,918
2001	325,330
2002	331,181

- Decreased surface area compromises the safety of boaters using the reservoir.
- Visual quality of the reservoir decreases due to exposed mud flats.
- Access to developed facilities from the shoreline becomes more difficult.
- Visitation to the reservoir decreases.
- As the mudflats dry, off-road vehicle use increases in these areas.

2. Rivers and Streams

a. Recreation Activities

The Truckee River is well known for its scenic values and water-based recreation opportunities. Most recreational activities within the area are directly water-based; hiking, camping, mountain biking, bird watching, picnicking, and sightseeing are popular activities that are indirectly linked to the river. The following water-based activities, discussed in more detail, are the most popular and are used as indicators to analyze the effects of the alternatives on the recreational resources within the study area.

i. Fly Fishing

The Truckee River and selected tributaries have a long history of fly fishing. Before the 1930's, the river was the only place in the world where an angler could catch 10-to-30-pound LCT. Although those days are gone ("Past Cumulative Effects"), LCT are being reintroduced into the river in hopes of establishing them throughout the system. Fly fishing is still one of the most popular recreational uses of the river.

ii. Spin/Lure/Bait Fishing

Anglers who use spinning and casting methods to catch fish are in a separate category than fly fishers. Although some anglers who use spinning or casting methods wade in the river, they most commonly fish from shore. Because the Truckee River has different regulations for different reaches, anglers who use spinning gear, lures, and bait tend to use sections that allow these methods. Spin, lure, and bait fishing methods can be more effective at flows that are higher and lower than those best suited for fly fishing.

Spin/lure/bait fishing is also popular in Donner Creek primarily because its family atmosphere appeals to the general angler. Bait anglers tend to be more oriented toward catching and keeping their limits (consumptive) than fly anglers, who tend to be more oriented toward catch and release.

iii. Rafting

From late June through early August, rafting is the most popular activity on the river. Commercial rafting (both guided and unguided) takes place on most reaches of the river downstream to Reno. Private rafters are known to use the entire river. Several of the counties license commercial outfitters, while public rafters are unregulated. Rafting does not occur on the Little Truckee River, Independence Creek, Donner Creek, or Prosser Creek.

More rafters use the upper section of the river than any other section. Rafting also takes place in the Reno/Sparks area and occasionally between Sparks and Pyramid Lake.

iv. Kayaking

Kayaking is a growing sport on the Truckee River. The river's physical characteristics make it an ideal environment for kayakers. From Class I to Class IV whitewater (depending on season and flows), the Truckee River has runs to suit the abilities of most kayakers. Although there are a few Class IV rapids (Bronco, Jaws, and Dead Man's Curve), 95 percent of the river is rated as Class II and III, which appeals to intermediate kayakers. Kayaking does not occur on the Little Truckee River, Independence Creek, Donner Creek, or Prosser Creek. (Ratings of the rapids are discussed under “Recreation Characteristics of Stream Reaches.”)

b. Recreation Characteristics of River Reaches and Streams

For purposes of this study, the Truckee River and its streams have been divided into a series of reaches, as shown on map 3.1. Each reach has unique characteristics that are attractive to different user groups and types of experiences desired, as described in the subsequent paragraphs.

Additionally, the following narrative uses the internationally-accepted river rating classification system to describe sections of whitewater or rapids for kayakers and rafters. These ratings are designed to give boaters an approximate difficulty of a given section of river so paddlers can match their skill levels to the particular demands of the river section. This river classification is accepted on rivers throughout the world. The system extends from Class I (easiest) to Class VI (most difficult). Most of the Truckee River is rated Class II or III, but a few rapids (Bronco, Jaws, and Dead Man's Curve) are considered Class IV. River classifications are subjective and change with flows in the river. The following list describes the characteristics that are considered for each class.

Class I—Easy
Fast-moving water with riffles and small waves. Few obstructions, all obvious and easily missed, with little training. Risk to swimmers is slight, and self rescue is generally easy.

Class II—Novice
Straightforward rapids with wide, clear channels, which are evident without scouting the river ahead. Occasional maneuvering may be required, but rock and medium sized waves are easily missed by trained paddlers. Swimmers are seldom injured, and group assistance, while helpful, is seldom required. Rapids at the upper end of this rating are rated as Class II +.

Class III—Intermediate
Rapids with moderate and irregular waves which may be difficult to avoid. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required. Large waves are present but are easily avoided. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims. Rapids at the upper end of this rating are rated Class III +.

Class IV—Advanced
Intense, powerful, but predictable rapids requiring precise boat handling in turbulent water. Rapids may require “must do” moves above dangerous hazards. Scouting the rapids is necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self rescue difficult. Group assistance for rescue is often essential but requires practiced skills. Rapids at the upper end of this rating are rated as Class IV +.

Class V—Expert
Extremely long, violent rapids which expose a paddler to above-average dangers. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. A very reliable "Eskimo roll," proper equipment, extensive experience, and practiced rescue skills are essential.

Class VI—Extreme
These runs have almost never been attempted and often exemplify the extremes of difficulty, unpredictability, and danger.

i. Donner Creek: Donner Lake Dam to Truckee River

Donner Creek is a small tributary that feeds into the Truckee River just upstream of the town of Truckee. Most recreational activity occurs on the segment of creek that runs through Donner Memorial State Park. Both fly and spin/lure/ bait fishing occur from the banks. Because the creek is small, rafting and kayaking do not occur.

Following are the recreation characteristics of this creek:

- Angling occurs on this section of the creek but is not considered as good as other areas within the study area (Aukerman, et al., 1999).
- Most of the fishing is by campers who stay in the nearby campgrounds.
- Spin and bait fishing seem to be the dominant form of angling.
- Most anglers are more generalists than “expert” fly anglers.
- Most of the creek is 15 to 30 feet wide and can be easily fished from its banks.

ii. Prosser Creek: Prosser Creek Reservoir to Truckee River

Prosser Creek is a small stream popular with fly anglers. Many anglers visit the stream when the Truckee River becomes crowded. Prosser Creek is accessible from westbound I-80, 4 miles west of Boca Reservoir.

Following are the recreation characteristics of this creek:

- It is popular with a relatively small number of fly anglers.
- It offers a higher degree of solitude than other streams in the study area.
- It has fewer spin/lure/bait anglers because of its size and challenges offered by vegetation and access.
- There is no rafting or kayaking.

iii. Independence Creek: Independence Lake to Little Truckee River

Independence Creek is another small stream that anglers visit when the Truckee River becomes crowded. Independence Creek is fairly remote.

Following are the recreation characteristics of this creek:

- It offers a high degree of solitude.
- It is popular with fly anglers.
- It has fewer spin/lure/bait anglers because of its size and challenges offered by vegetation and access.

- There is no rafting or kayaking.

Desired flows for stream-based fishing in Independence Creek were not established.

iv. Little Truckee River: Independence Creek to Stampede Reservoir

The meadow reaches of the upper Little Truckee fish well in early summer as soon as runoff subsides. Rainbow trout from Stampede Reservoir move into the gravel bars to spawn and many remain as the water level drops. Because the creek is small, rafting and kayaking do not occur.

Following are the recreation characteristics of this section of the tributary:

- It offers high degree of solitude.
- It is becoming popular with fly anglers.
- It has fewer spin/lure/bait anglers than fly anglers because of its size and challenges offered by vegetation and access.
- There is no rafting or kayaking.

v. Little Truckee River: Stampede Reservoir to Boca Reservoir

The reach between Stampede and Boca Reservoirs is heavily used by anglers of all types during the early spring (May and June) and after the spring runoff has subsided to 500 cfs or less. Fly and bank anglers congregate where the Little Truckee River enters Boca Reservoir because of easy access and quality fishing. Prolific insect populations and quality habitat support a highly productive fish population.

Following are the recreation characteristics of this section of the tributary:

- It has open meadows and valleys popular with fly and spin/lure/bait anglers.
- Only artificial lures with barbless hooks can be used, and the maximum size allowed to be kept is 14 inches, with a bag limit of two.
- It has a large population of fish.
- It has ample parking and access.
- There is no rafting or kayaking.

vi. Truckee River: Lake Tahoe to Donner Creek

The Truckee River begins at the outlet of Lake Tahoe at the small dam on the lake's northwest shore. This reach of river has more recreational activity than any other reach. Recreational activities are prohibited for 1,000 feet downstream from "Fanny Bridge" at the outlet. Fanny Bridge is a popular spot to view very large rainbow trout waiting for tourists to throw them a free meal as they sit in the highly oxygenated water. Unguided rafting is the most popular recreational activity. Two licensed rafting companies operate on this reach. Each is allowed 100 rafts on the water at any given time. The rafting season ranges from the middle of June through early September, depending on river temperature and flow. A public boat launch provides easy access for those with their own rafts. It is unlawful for watercraft to operate on the river if the flows exceed 1,250 cfs. The commercial rafting companies cannot send rafts out before 10 a.m. or after 4 p.m. to allow anglers a raft-free river at peak fishing times and also to reduce conflicts among different user groups on the river. Most commercial rafting companies stop renting rafts when flows are below 100 cfs.

Fishing occurs throughout the fishing season but is more popular during the early spring and fall when rafting activity has subsided. This reach of river is rated as Class I, with Class II and Class III water closer to Truckee. A bike path that parallels this reach of river has greatly increased use by bicyclists, joggers, rollerbladers, and walkers. The greatest dangers for boaters are private bridges, which have little clearance during high flows.

USFS has three campgrounds (Silver Creek, Goose Meadows, and Granite Flats) along this reach. Heavy use of this river reach can be attributed to the location of these campgrounds and easy access to the river. While most of the river is easily accessible to recreational users, many homes (especially on the eastern side of the river) and private properties are posted against trespassing.

Following are the recreation characteristics of this reach of river:

- Rafting is one of the most popular recreational activities, although both fly and spin/lure/bait fishing occur.
- Commercial rafting companies use this section of river.
- People are abundant, and solitude is not an important aspect of the recreation experience.

vii. Truckee River: Donner Creek to Little Truckee River

This reach begins at the Donner Creek confluence (Ollie's Bridge) at the southwest corner of the town of Truckee. An unimproved parking area with a capacity of about 10 vehicles is a popular access point for kayakers who wish to boat the challenging "Town Section" of the river (rated as Class III) during spring runoff. For anglers, the most popular segment of this reach parallels Glenshire Road, where many pullouts and unimproved parking areas provide easy access to the river. From Trout Creek to Gray Creek, the river is designated as "wild trout water." Both fly and spin/lure/bait fishing occur, but fly fishing is more common. The most popular times to fish this reach are April and May (before the peak spring runoff occurs) and late July through the end of the fishing season on October 15.

The segment between Glenshire Bridge and Boca Bridge is popular with recreational boaters and is rated as Class II. This 4.5-mile segment offers easy access points at both bridges. Although considered a Class II section, at higher flows (4,000 cfs), many consider it Class III. Fishing in this segment has resulted in confrontations with the San Francisco Flycasters, who own 0.5 mile of property along the river and restrict foot access. However, those floating through on watercraft are allowed to fish. Fishing becomes popular when flows are below 800 cfs in both the spring and fall. Wading is more difficult here than in other reaches of the river; consequently, spin/lure/bait fishing is more popular in this reach than fly fishing.

Prosser Creek enters the Truckee River in this reach and offers anglers (willing to walk) fine small-stream fishing. Prosser Creek at the confluence is accessible from I-80 west by turning north on an unimproved road. This area is popular among fly fishers and is known as “Joe's Schoolyard.” Long, smooth runs make the area around the Prosser Creek inflow attractive to the dry fly enthusiast. Fishing in the Prosser Creek area is most popular in August and September. The Little Truckee River enters the Truckee River just before Boca Bridge and is a popular put-in point for commercial rafting companies.

Following are the recreation characteristics of this reach of river:

- It is popular with kayakers, especially during the spring.
- At lower flows, anglers replace kayakers.
- Both spin/lure/bait anglers rate this stretch of river “good” on a scale of excellent to poor (Aukerman, et al., 1999).
- The river through the town of Truckee is a popular intermediate to advanced run for kayakers.
- From the east end of Truckee to Hirshdale Bridge, fly fishing is very popular.
- Along the Truckee River from Trout Creek to the Boca Bridge, only artificial lures with barbless hooks can be used, and the minimum size fish allowed to be kept is 15 inches, with a bag limit of two.
- From Glenshire Bridge to Boca Bridge, fishing and boating are equally popular.

viii. Truckee River: Little Truckee River to State Line

This reach is the most popular with commercial rafting companies. Most outfitters put in at the Little Truckee confluence a few hundred yards from Boca Bridge and take out at Floriston. Much of this reach is Class II and III except the last 0.5 mile, which contains the Class IV Bronco and Jaws rapids. Rafting occurs when flows range from 1,000 to 4,000 cfs. Numerous rafting guides consider flows of about 2,000 cfs to be "ideal." This reach is also popular with more experienced kayakers. The area around Boca Bridge is popular with anglers because of its easy access and quality fishing.

Following are the recreation characteristics of this reach of river:

- The most heavily used reach of the Truckee River for rafting and kayaking is from Boca Bridge to Floriston.
- It is the most heavily used by commercial rafters.
- Fishing is popular, but access is limited due to the distance from the highway.

ix. Trophy

Just downstream from Floriston Bridge, where the washed out Farad diversion dam is located, is a popular spot for kayakers to “surf” and execute “rodeo” moves on the wave produced by a concrete slab from the fallen dam. Commercial and private rafters and kayakers often use this reach of river. This reach is rated as Class II, except for the portion from Farad to Verdi, which contains both Dead Man's and Staircase rapids (both considered Class IV whitewater). This reach requires three portages because of concrete diversion dams (Fleish, Steamboat Canal, and Verdi). Crystal Peak Park at the west end of Verdi is a popular recreation site that offers improved facilities and easy access to the river. Although this is not a popular put-in site for boaters, rafters and kayakers frequently pass through. Spin/lure/bait fishing is popular and productive because of many deep holes that hold trout.

Following are the recreation characteristics of this reach of river:

- It is popular with rafters and kayakers.
- Floriston to Verdi is considered more suitable for advanced river runners, with numerous Class III rapids and one Class IV rapid (Dead Man’s Curve).
- Crystal Peak Park on the west side of Verdi is popular with anglers and offers good access to the river.
- Anglers have good access to the river on the east side of Verdi
- Spin/lure/bait angling is the most popular type of fishing.

x. Mayberry, Oxbow, and Spice

These reaches are considered together because of the homogeneous characteristics of recreational use. This "urban" section of the Truckee River is easily accessible because of the many parks that line the river through downtown Reno and Sparks. Some limited rafting and kayaking occur during March, April, and May when the spring runoff begins. A kayak slalom course near Mayberry Bridge is used in the early spring and summer months. During the hot summer months, rafters occasionally use this reach to "play" in the river to beat the hot temperatures. Fishing is the most popular recreational activity. Although some fly fishing occurs, spin/lure/bait fishing is more popular. Several anglers who fish this reach say fishing is good because of the periodic stocking by NDOW. Stocking begins in March and continues through September, with rainbow trout released every 2 weeks from Sparks west to Verdi. Most fishing takes place during the late spring and summer when the flows have started to decline from the spring runoff.

Recently, Nevada’s first whitewater park and kayak slalom racing course opened in this stretch of river, in the heart of the downtown Reno hotel-casino district. The whitewater course features 11 “drop pools,” a slalom racing course, and more than 7,000 tons of smooth, flat rocks along the shores to aid access to the river.

Following are the recreation characteristics of this reach of river:

- Portions of this reach of river are stocked with “catchable” sized rainbow trout, increasing its popularity for fishing.
- Reno and Sparks have many river parks that allow access to the river.
- Spin/lure/bait fishing is the most popular form of fishing, although some fly fishing occurs.
- There are several kayak slalom courses established in this reach of river.
- Private raft and kayak use is more prevalent than use by commercial recreation service providers.

xi. Lockwood and Nixon

Some minimal recreational use occurs on these reaches, including spin/lure/bait fishing and rafting. From Sparks, the river flows through a hot and dry desert environment for approximately 40 miles along I-80 until it leaves the highway and enters the Pyramid Lake Indian Reservation. Because of the large amount of private property, the only river access site commonly used along I-80 is near Derby Diversion Dam.

Following are the recreation characteristics of this reach of river:

- Recreational use is much less than on other reaches of river.
- Access to the river on the Pyramid Lake Tribal lands is by permit only, which may serve to discourage some users.
- Rafting and kayaking are minor activities.

c. Desired Flows

Desired flows within the context of this recreation analysis are flows most desired by recreationists for their particular water-based activity. These are not the California Guideline flows for fish. Desired flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking for this study were developed using information obtained through a study commissioned by BOR (Aukerman et al., 1999). The desired flows for the various recreation activities used in this study were derived from the average flows as recommended by professional outfitters and guides because of their extensive knowledge and experience with both professional and private recreational use of the river and their knowledge of instantaneous flows on the river.

Desired flows were used to provide a measure of the quality of a river recreation experience under the alternatives analyzed in this study. Desired flows are subjective and depend on the type of experience desired and the skill level of the user. A recreationist may still choose to participate in a given activity even if flows are less than or greater than preferred. In this case, their experience may be less than expected; however, for commercial enterprises, it is generally the goal of recreation managers to provide a setting conducive to maximizing the participant’s satisfaction with the experience.

Rafters and kayakers prefer higher water conditions, which provide for more exciting and challenging runs down the river. Higher flows produce "standing waves," such as the popular "park and surf" just downstream from Floriston Bridge discussed previously. Changes in flows can increase or decrease the difficulty rating of a particular section of river. A section that is rated as Class III (such as the Boca to Floriston run) at flows above 1,500 cfs is rated as Class II at flows below 800 cfs.

Overall, anglers prefer more moderate to lower flows than rafters and kayakers. Fly anglers look for flows that allow for easy wading and access to fish-holding water, which might be in the middle of the river, and obstructions that hold trout. Although not necessary, wading increases a fly angler's enjoyment and success rate. Higher flows also limit commercial guiding opportunities because increased flows may be dangerous for inexperienced anglers. Some guides will not take clients on the river when high flows create an unacceptable risk. Bank anglers tend to be less particular about flow levels because they do not need to enter the river. However, flows that rapidly increase or decrease adversely affect success rates of both groups of anglers.

Table 3.73 presents the range of desired flows for these stream-based recreation activities for the river reaches used in this analysis. (See the Economics and Recreation Appendix for further information on development of desired flows.)

Table 3.73.—Desired flows (cfs) for stream-based recreation in the Truckee River basin

Reach	Fly fishing	Spin/lure/bait fishing	Rafting	Kayaking
Donner Creek: Donner Lake to Truckee River	40-70	40-70	Not applicable	Not applicable
Prosser Creek: Prosser Creek Reservoir to Truckee River	40-70	40-70	Not applicable	Not applicable
Independence Creek: Independence Lake to Little Truckee River	No data	No data	Not applicable	Not applicable
Little Truckee River: Independence Creek to Stampede Reservoir	40-70	40-70	Not applicable	Not applicable
Little Truckee River: Stampede Reservoir to Boca Reservoir	100-250	200-500	Not applicable	Not applicable
Truckee River: Lake Tahoe to Donner Creek	350-600	350-800	400	1,000
Truckee River: Donner Creek to Little Truckee River confluence	400-500	400-800	900-1,200	900-1,200
Truckee River: Little Truckee River to State line	400-500	400-800	900-1,200	1,000-1,200
Trophy	500-700	500-600	2,000-4,000	2,000-4,000
Mayberry, Oxbow, Spice	500-800	600-800	2,000-4,000	2,000-4,000
Lockwood, Nixon	1,000-1,500	1,000-3,000	1,000-3,000	1,000-3,000

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

Modifying operations of Truckee River reservoirs could affect lake and reservoir elevations and the quality, quantity, timing, and duration of flows. In turn, these changes could affect water-based recreation activities in the study area. This analysis evaluated the effects of changes in elevations and flows on water-based recreation using the following indicators:

1. Lake- and reservoir-based recreation:

    - Seasonal recreation visitation (as measured by overnight and day use visitors correlated to reservoir elevation and reservoir surface area)

    - Boat ramp usability (as measured by water surface elevation from April through October).

    - Effects of fluctuating elevation on use of stationary docks at Donner Lake.

2. Stream-based recreation:

    - Suitability of flows for stream fishing during the recreation season (fly fishing and spin/lure/bait fishing) (as measured by number of months that desired flows occur).

    - Suitability of flows for rafting during the recreation season (as measured by number of months that desired flows occur).

    - Suitability of flows for kayaking during the recreation season (as measured by number of months that desired flows occur).

B. Summary of Effects

Analysis of operations model results, in general, shows the following:

Visitation at Prosser Creek, Stampede, and Boca Reservoirs generally would be greater under TROA than under No Action and current conditions, primarily because annual average water elevations would be higher under TROA, thus enhancing recreational access and ensuring a higher quality recreational experience. Visitation at Donner Lake would be negligibly (less than 1 percent) less under TROA than under current conditions, but greater than under either No Action or LWSA.

Effects on boat ramp usability would be the same in all hydrologic conditions at Pyramid Lake and Prosser Creek and Lahontan Reservoirs under TROA, LWSA, and No Action.

Boat ramps would be more usable in median hydrologic conditions at Donner Lake; in dry hydrologic conditions at Stampede Reservoir, and in wet hydrologic conditions at Boca Reservoir under TROA than under No Action and LWSA. Boat ramps would be less usable in dry hydrologic conditions at Donner Lake and in median hydrologic conditions at Boca Reservoir under TROA than under No Action. Usability of stationary docks at Donner Lake would not be significantly affected under any alternative in June, July, or August.

Effects on flows for fly fishing, rafting, and kayaking would be minimal under No Action, LWSA, and TROA. Because of the nature of spin/lure/bait fishing, and because anglers can and will still pursue their sport when flows are either greater or less than preferred, none of the effects on flows under any of the alternatives is considered significant.

Table 3.74 summarizes the effects of the alternatives on water-based recreation.

Table 3.74.—Summary of effects on water-based recreation

Indicator	No Action	LWSA	TROA
Seasonal recreation visitation	Same as under current conditions, except slightly less at Donner Lake in median hydrologic conditions.	Same as under No Action, except slightly more at Donner Lake in median hydrologic conditions.	Same as under No Action, except more at Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs in some hydrologic conditions.
Boat ramp usability	Same as under current conditions, except slightly more usable at Boca Reservoir in wet hydrologic conditions.	Same as under No Action.	Same as under No Action, except slightly more or less usable at Donner Lake and Boca Reservoir in certain hydrologic conditions.
Suitability of flows for fly fishing	Same as under current conditions, with a few exceptions.	Same as under No Action.	Same as under No Action.
Suitability of flows for spin/lure/bait fishing	Desired flows would occur more often in the Little Truckee River from Independence Creek to Stampede Reservoir and in the Trophy reach in wet hydrologic conditions and less often in the Mayberry, Oxbow, and Spice reaches in dry hydrologic conditions than under current conditions.	Same as under No Action, except desired flows would occur more often in the Mayberry, Oxbow, and Spice reaches in median hydrologic conditions.	Desired flows would occur more often in Prosser Creek in median hydrologic conditions and in the Mayberry, Oxbow, and Spice reaches in wet hydrologic conditions and less often in several reaches, primarily in wet hydrologic conditions, than under No Action and current conditions.
Suitability of flows for rafting	Same as under current conditions.	Same as under No Action.	Same as under No Action, except that desired flows would occur less often in the Truckee River from Lake Tahoe to Donner Creek in wet hydrologic conditions and more often in the Mayberry, Oxbow, and Spice reaches in wet hydrologic conditions.

Table 3.74.—Summary of effects on water-based recreation

Indicator	No Action	LWSA	TROA
Suitability of flows for kayaking	Same as under current conditions.	Same as under No Action.	Same as under No Action, except that desired flows would occur less often in the Truckee River from Lake Tahoe to Donner Creek in wet hydrologic conditions and more often in the Mayberry, Oxbow, and Spice reaches in wet hydrologic conditions.

C. Lake- and Reservoir-Based Recreation Visitation

1. Method of Analysis

Differences in seasonal recreation visitation at lakes and reservoirs were quantified by the number of overnight and day use visitors during the recreation season compared to changes in reservoir surface acres during the same period. Recreation model results (described in "Economic Environment) were used to determine numbers of overnight and day use visitors. Recreation visitation used in this analysis reflects only recreation that occurs during the 7-month prime recreation season, April through October. Therefore, recreation visitation shown in this section is less than that shown in the analysis of the economic environment, which considers the entire year. Operations model results were used to determine reservoir surface acres.

Boat ramp usability was quantified as the percent of the recreation season that reservoir elevation equaled or exceeded the elevation suitable for launching large and mid-sized watercraft. Elevations were generated by the operations model. Note that boat ramp usability is not absolute because it depends on a number of factors, such as the type of watercraft, slope of the boat ramp, lake or reservoir bottom structure at the toe of the ramp, and emergence of potential hazards, such as large rocks or stumps.

Stationary dock use at Donner Lake was quantified as the number of draw downs between elevations 5931.5 and 5935.5 feet in June, July, and August, as shown by operations model results.

Lahontan Reservoir was not included in the survey and subsequent modeling that established a relationship between visitation and changes in reservoir surface acres. Therefore, operations model results were used to determine the average amount of available surface acres available during the recreation season in wet, median, and dry hydrologic conditions, and inferences were drawn regarding recreationists' response to the surface acres available. As the elevation (and, thus, surface acres) of Lahontan Reservoir declines, mud flats develop and the quality of the fishing experience decreases. As a result, fewer recreationists are attracted to the area.

2. Threshold of Significance

This section identifies thresholds of significance for recreation visitation, boat ramp usability, and use of stationary docks at Donner Lake.

a. Recreation Visitation

Analysis of recreation and operations model results, in general, shows that as elevation declines, the number of visitors decline. It is difficult, however, to identify a point at which declining number of visitors becomes significant, because for some recreationists, fewer visitors translates into a higher quality recreation experience. A better indicator of the significance of declining visitation is the economic impact realized from fewer visitor expenditures. (See “Economic Environment” for the economic significance of declining visitation.)

As visitor numbers decline, there is less competition for available facilities and services, enhancing the experience for some visitors. However, a declining user population can prompt resource management agencies to reallocate capital investments and services to areas with greater visitation. Therefore, visitors accustomed to certain levels of facilities and services might find that as visitation declines, they will have fewer fish to catch or restrooms boat launch facilities to use. The visitation level at which agencies would consider reallocating capital investments and services cannot be readily quantified.

b. Boat Ramp Usability

The effect of operations on the reservoir and lake elevations becomes significant when watercraft can no longer be launched from constructed boat ramps. For this indicator, an effect was considered significant when operations model results show the elevation is at the toe or base of the ramp, thus rendering the ramp unusable (‘high and dry”). However, a second threshold was used for analyzing overall boat ramp usability. For the second analysis, it was assumed that large- and mid-sized watercraft generally cannot be safely launched when there is less than 3 feet of water on the mid or lower portion of the ramp. However, some smaller watercraft can be launched. Therefore, at these lower elevations, a boat ramp was considered “less than fully usable” but not completely unusable.

c. Stationary Dock Use at Donner Lake

An effect on stationary dock use at Donner Lake was considered significant if the elevation was below 5934 feet. As discussed previously, stationary dock use at Donner Lake was analyzed using operations model results to show the number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August. Only these months were analyzed because dam safety requirements specify that the discharge gates of the dam be held open from November 15 through April 15 to prevent the lake from exceeding elevation 5926.9 feet, and draw downs may occur in September and October in anticipation of opening the discharge gates to meet this requirement. Furthermore, the 1943 Donner Lake Indenture directs that elevation of Donner Lake not be allowed to fall below 5932 feet in June, July, and August, except to meet minimum flow requirements. (See chapter 2). This indenture ensures that significant effects do not occur during the prime recreation season in other than drought conditions.

3. Model Results

Table 3.75 presents seasonal recreation visitation; table 3.76a presents the percent of the recreation season that boat ramps are unusable ("high and dry"); table 3.76b presents the percent of the recreation season that boat ramps are usable for large- and mid-sized watercraft; table 3.76c presents average surface acres at Lahontan Reservoir; and table 3.77 presents the number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August at Donner Lake. Elevations below 5934 feet are not acceptable for stationary dock use.

Table 3.75.—Seasonal recreation visitation
(as measured by the number of overnight visitors and day use visitors from April through October)

Lake/reservoir	Hydrologic condition	Current conditions	No Action	LWSA	TROA
Donner	Wet	127,626	127,643	127,643	127,578
	Median	123,566	116,939	97,821	118,324
	Dry	98,781	98,788	98,788	98,534
Prosser Creek	Wet	20,600	20,640	20,640	21,369
	Median	18,519	18,928	21,032	20,031
	Dry	8,738	10,710	10,801	14,612
Stampede	Wet	71,383	71,398	71,368	71,414
	Median	69,019	68,703	71,194	71,136
	Dry	15,642	15,852	15,838	39,989
Boca	Wet	29,716	29,740	29,744	29,454
	Median	24,976	24,844	25,034	25,874
	Dry	8,883	8,739	8,724	10,992

Table 3.76a.—Percent of the recreation season boat ramps are unusable ("high and dry")

Lake/reservoir	Hydrologic condition	Current conditions	No Action	LWSA	TROA
Donner	Wet	0	0	0	0
	Median	0	0	0	0
	Dry	0	0	0	0
Prosser Creek	Wet	0	0	0	0
	Median	0	0	0	0
	Dry	86	100	71	28
Stampede	Wet	0	0	0	0
	Median	0	0	0	0
	Dry	100	100	100	0
Boca	Wet	14	0	14	14
	Median	42	42	42	42
	Dry	100	100	100	100
Lahontan	Wet	0	0	0	0
	Median	0	0	0	0
	Dry	42	42	42	42
Pyramid	Wet	0	0	0	0
	Median	0	0	0	0
	Dry	0	0	0	0

Table 3.76b.—Percent of the recreation season boat ramps are usable for large and mid-sized watercraft

Lake/reservoir	Hydrologic condition	Current conditions	No Action	LWSA	TROA
Donner	Wet	71	71	71	71
	Median	57	57	57	71
	Dry	57	57	57	42
Prosser Creek	Wet	86	86	86	86
	Median	86	86	86	86
	Dry	0	0	0	28
Stampede	Wet	100	100	100	100
	Median	100	100	100	100
	Dry	0	0	0	100
Boca	Wet	57	71	71	86
	Median	57	57	57	43
	Dry	0	0	0	0
Lahontan	Wet	100	100	100	100
	Median	100	100	100	100
	Dry	57	57	57	57
Pyramid	Wet	100	100	100	100
	Median	100	100	100	100
	Dry	100	100	100	100

Table 3.76c.—Average surface acres at Lahontan Reservoir from April through October

Hydrologic condition	Current conditions	No Action	LWSA	TROA
Wet	12,444	12,520	12,529	12,520
Median	6,702	6,604	6,600	6,588
Dry	4,207	3,673	3,659	3,651

Table 3.77.—Stationary dock use at Donner Lake
Number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August

Elevation (feet)	Current Conditions	No Action	LWSA	TROA
June				
5935.5	22	22	22	24
5935.0	17	17	17	19
5934.5	10	10	10	13
5934.0	5	5	5	7
5933.5	2	2	2	4
5933.0	1	1	1	1
5932.5	0	0	0	0
5932.0	0	0	0	0
5931.5	0	0	0	0
July				
5935.5	37	37	37	53
5935.0	20	20	20	30
5934.5	16	16	16	21
5934.0	12	12	12	17
5933.5	8	8	8	8

Table 3.77.—Stationary dock use at Donner Lake
Number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August

Elevation (feet)	Current Conditions	No Action	LWSA	TROA
5933.0	3	3	3	4
5932.5	1	1	1	1
5932.0	0	0	0	0
5931.5	0	0	0	0
August				
5935.5	81	81	81	92
5935.0	41	41	41	62
5934.5	24	24	24	48
5934.0	19	19	19	30
5933.5	13	13	13	21
5933.0	10	10	10	11
5932.5	6	6	6	7
5932.0	2	2	2	2
5931.5	0	0	0	0

4. Evaluation of Effects

a. No Action

i. Donner Lake

Recreation model results show about the same number of visitors at Donner Lake under No Action and current conditions in wet and dry hydrologic conditions. The greatest difference occurs in median hydrologic conditions, when there are 6,627 fewer visitors under No Action than under current conditions, or 5 percent less, a minor difference, but it could have the following effect:

- Enhanced recreation experience for users that place a high value on solitude.
- Reallocation of capital investments and services to areas with greater visitation.

Operations model results show that boat ramp usability at Donner Lake is the same under No Action as under current conditions in all hydrologic conditions.

For stationary docks at Donner Lake, operation model results show the same number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August under both No Action and current conditions.

ii. Prosser Creek Reservoir

Recreation model results show 409 more visitors at Prosser Creek Reservoir under No Action than under current conditions in median hydrologic conditions, or about 2 percent more, which would have negligible effect. In wet hydrologic conditions, model results show even less difference between No Action and current conditions (40), or less than a 1-percent difference, and would have negligible effect.

In dry hydrologic conditions, recreation model results show 1,972 fewer visitors under No Action than under current conditions (18 percent less), which could have the following effects:

- Fewer impacts on private landowners within upland areas surrounding the reservoir because of fewer visitors.
- Less competition among recreationists for use of the recreational resources and facilities, although the recreation experience would likely be highly diminished because of low water.
- Displacement of visitors to other destinations within the study area, increasing the burden on the operational resources of those areas. Additionally, concentrating recreationists where suitable water exists could result in crowding and increased pressure on those resources.

Operations model results show that boat ramps at Prosser Creek Reservoir are fully usable 86 percent of the recreation season in wet and median hydrologic conditions under No Action and current conditions. In dry hydrologic conditions, operations model results show that boat ramps are unusable throughout the recreation season under both No Action and current conditions. As a result, boat launching could be difficult because of low water conditions. Visitors could experience bottom and propeller damage. Additionally, site managers could have increased maintenance costs associated with a higher incidence of damage to the boat ramp surface and increased eroding of rock, soil, and gravel at the toe of the ramp.

iii. Stampede Reservoir

Recreation model results show 15 fewer visitors at Stampede Reservoir in wet hydrologic conditions, 316 fewer visitors in median hydrologic conditions, and 210 more visitors in dry hydrologic conditions under No Action than under current conditions. In all cases, this is less than a 1 percent difference and would have negligible effect.

Operations model results show that boat ramp usability at Stampede Reservoir is the same under No Action and current conditions: boat ramps are fully usable 100 percent of the recreation season in wet and median hydrologic conditions and less than fully usable in dry hydrologic conditions.

iv. Boca Reservoir

Recreation model results show less than a 1 percent difference in the number of visitors at Boca Reservoir between No Action and current conditions, which would have negligible effect.

Operations model results show that boat ramp usability at Boca Reservoir is about the same under No Action and current conditions. In wet hydrologic conditions, boat ramps are usable 71 percent of the recreation season under No Action compared to 57 percent under current conditions. Under both No Action and current conditions, boat ramps are usable 57 percent of the season in median hydrologic conditions and unusable throughout the recreation season in dry hydrologic conditions.

Therefore, the following effects could occur:

- Diminished recreation experience in August, September, and October in median hydrologic conditions because of difficult boat launching.
- Diminished recreation experience throughout the recreation season in dry hydrologic conditions because of difficult boat launching.
- Increased maintenance costs associated with a higher incidence of damage to the boat ramp surface and increased eroding of rock, soil, and gravel at the toe of the ramp.

iv. Lahontan Reservoir

Operations model results show that average surface acres are about the same under No Action as under current conditions in all three hydrologic conditions; as a result, the number of recreationists likely would be about the same. Boat ramp usability is the same as under current conditions.

b. LWSA

i. Donner Lake

Recreation model results show about the same number of visitors at Donner Lake under LWSA, No Action, and current conditions in wet and dry hydrologic conditions.

However, in median hydrologic conditions, there are 19,118 fewer visitors under LWSA than under No Action in median hydrologic conditions, or approximately 16 percent less. Additionally, there are 25,745 fewer visitors under LWSA than under current conditions, or approximately 26 percent less. As a result, the following effects could occur in median hydrologic conditions:

- Enhanced recreation experience for visitors seeking solitude because of less crowding and competition for available facilities and services.

- Displacement of visitors to other destinations, increasing the burden on the operational resources of those areas. Additionally, concentrating recreationists where suitable water exists could result in crowding and increased pressure on those resources.

- Reallocation of capital investments and services to areas with greater visitation. Fewer impacts on private landowners within upland areas surrounding the reservoir because of fewer visitors.

Operations model results show that boat ramp usability is virtually the same under LWSA, No Action and current conditions: boat ramps are fully usable 71 percent of the recreation season in median hydrologic conditions and fully usable about 57 percent of the season in median and dry hydrologic conditions. However, in all three cases, boat ramps are less than fully usable in April, September, and October, when visitation is much less. Therefore, effects would be much less than if the boat ramps were not fully usable in the prime recreation months of June, July, and August.

For stationary docks at Donner Lake, operation model results show the same number of draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August under LWSA, No Action, and current conditions. Elevations of less than 5934 feet seldom occur. Thus, effects on stationary docks at Donner Lake would be relatively minor.

ii. Prosser Creek Reservoir

Recreation model results show the same number of visitors at Prosser Creek Reservoir under LWSA as under No Action and 40 fewer than under current conditions in wet hydrologic conditions, or less than a 1 percent difference, which would have negligible effect.

In median hydrologic conditions, there are 1,104 more visitors under LWSA than under No Action and 1,513 more than under current conditions, or about 7 percent more.

In dry hydrologic conditions, there are 91 more visitors under LWSA than under No Action, and 2,063 more visitors than under current conditions, or less than 1 percent more than under No Action and 19 percent more than under current conditions.

As a result, the following effects could occur under LWSA in dry hydrologic conditions:

- Diminished recreation experience for users that place a high value on solitude.

- Greater impacts on private landowners within upland areas surrounding the reservoir because of increased incidents of trespass and other impacts resulting from more visitors.

- Increased burden on operational resources of managing agencies because of greater visitation.

Operations model results show that in wet hydrologic conditions, boat ramps are usable 86 percent of the recreation season under the LWSA, 14 percent less than under No Action and the same as under current conditions.

In median hydrologic conditions, boat ramps are usable 86 percent of the recreation season—the same as under No Action and 28 percent more than under current conditions. In dry hydrologic conditions, boats ramps are less than fully usable throughout the recreation season under LWSA, No Action, and current conditions. Thus, the effects in dry hydrologic conditions would be the same as under No Action.

iii. Stampede Reservoir

Recreation model results show 30 fewer visitors at Stampede Reservoir under LWSA than under No Action and 15 more than under current conditions in wet hydrologic conditions, or less than a 1 percent difference in both cases, which would have negligible effect.

In median hydrologic conditions, there are 2,491 more visitors under LWSA than under No Action and 2,175 more than under current conditions, or a 3 percent difference, which would have negligible effect.

In dry hydrologic conditions, there are 14 more visitors under LWSA than under No Action and 196 more than under current conditions. Again, this is about a 1 percent difference, and is also of little consequence in terms of differences between alternatives or effects on the recreational resource.

Operations model results show that boat ramp usability at Stampede Reservoir is the same under LWSA, No Action, and current conditions. Thus, the effects would be the same as under No Action.

iv. Boca Reservoir

Recreation model results show 4 more visitors at Boca Reservoir under LWSA than under No Action and 28 fewer visitors than under current conditions in wet hydrologic conditions; 190 more than under No Action and 58 more than under current conditions in median hydrologic conditions; and 15 fewer under than under No Action and 159 fewer than under current conditions in dry hydrologic conditions. Each of these differences is less than 1 percent and would have negligible effect.

Operations model results show that boat ramp usability is the same under LWSA as under No Action and current conditions. Thus, the effects would be the same as under No Action.

iv. Lahontan Reservoir

Operations model results show that average surface acres are about the same under LWSA as under No Action and current conditions in all three hydrologic conditions; as a result, the number of recreationists likely would be about the same. Boat ramp usability is the same as under No Action and current conditions.

c. TROA

i. Donner Lake

Recreation model results show 125 fewer visitors at Donner Lake under TROA than under No Action and 108 more than under current conditions in wet hydrologic conditions; 1,385 more than under No Action and 5,242 more than under current conditions in median hydrologic conditions; and 254 fewer than under No Action and 247 fewer than under current conditions in dry hydrologic conditions. In all cases, the differences are less than 4 percent and would have negligible effect.

Operations model results show that boat ramps are usable 71 percent of the recreation season under TROA, No Action, and current conditions in wet hydrologic conditions; usable 71 percent of the season under TROA compared to 57 percent of the season under No Action and current conditions in median hydrologic conditions; and usable 71 percent of the season under TROA compared to 43 percent of the season under both No Action and current conditions in dry hydrologic conditions.

Thus, the following effects could occur:

- Same effect as under No Action in wet hydrologic conditions.

- Minimal disruption to boaters in median hydrologic conditions, because boat ramps would be more usable under TROA than under current conditions or the other alternatives. Moreover, under TROA, boat ramps would be less than fully usable in April and October, when usage is lowest.

- Better conditions for boaters in dry hydrologic conditions under TROA than under No Action or current conditions, because boat ramps would be usable in two more months.

- In the periods when boat ramps could be less than fully usable, diminished recreation experience because of difficulties associated with launching large- and mid-sized watercraft.

- In periods when boat ramps could be less than fully usable, increased maintenance costs associated with a higher incidence of damage to the boat ramp surface and increased eroding of rock, soil, and gravel at the toe of the ramp.

For stationary docks at Donner Lake, operation model results show slightly more draw downs between elevation 5935.5 and 5932.5 feet in June, July, and August under TROA than under either No Action or current conditions. As the elevation drops below 5934 feet, however, draw downs occur less frequently under TROA. Overall, effects on stationary docks at Donner Lake would be minor under TROA.

ii. Prosser Creek Reservoir

Recreation model results show 729 more visitors at Prosser Creek Reservoir under TROA than under No Action and 769 more visitors than under current conditions in wet hydrologic conditions, a difference of about 3 percent in both cases, which would have negligible effect.

In median hydrologic conditions, there are 1,103 more visitor under TROA than under No Action and 1,512 more than under current conditions, differences of 5 and 7 percent, respectively.

In dry hydrologic conditions, there are 3,902 more visitors under TROA than under No Action and 5,874 more visitors than under current conditions, or 27 and 40 percent more, respectively. Potential effects of these differences follow. Dry hydrologic conditions are often temporary, so the following effects would most likely be temporary as well:

- Diminished recreation experience for users that place a high value on solitude.
- Diminished recreation experience because of increased competition for the use of available services and facilities.
- Possibly more and better services and facilities in response to higher visitation.

Operations model results show that boat ramp usability is the same under TROA as under No Action and current conditions. Therefore, the effects would be the same as under No Action.

iii. Stampede Reservoir

Recreation model results show 16 more visitors at Stampede Reservoir under TROA than under No Action and 31 more than under current conditions in wet hydrologic conditions; 2,433 more than under No Action and 2,117 more visitors than under current conditions in median hydrologic conditions. In all cases, these differences are less than 3 percent and would have negligible effect.

However, in dry hydrologic conditions, recreation model results show 24,137 more visitors under TROA than under No Action and 24,347 more than under current conditions, or approximately 60 percent more in both cases. Thus, the following effects could occur in dry hydrologic conditions:

- Existing facilities would be sufficient to prevent crowding and overuse.

- Capital investments and services could be reallocated to areas with greater visitation, resulting in an overall decrease in services and facilities, and, thus, adversely affecting the recreation experience.

Operations model results show that boat ramp usability is the same under TROA, No Action, and current conditions. Thus, the effects would be the same as under No Action.

iv. Boca Reservoir

Recreation model results show 286 fewer visitors at Boca Reservoir under TROA than under No Action and 262 fewer than under current conditions in wet hydrologic conditions; 1,030 more than under No Action and 898 more than under current conditions in median hydrologic conditions; and 253 more than under No Action and 109 more than under current conditions and in dry hydrologic conditions. In all cases, this is less than a 3 percent difference and would have negligible effect.

In wet hydrologic conditions, operation model results show that boat ramps are 86 percent of the recreation season under TROA, compared to 71 percent under No Action and 57 percent under current conditions. Thus, boaters would have better access under TROA in wet hydrologic conditions.

In median hydrologic conditions, boat ramps are usable 57 percent of the recreation season under both No Action and current conditions but usable only 43 percent of the recreation season under TROA. The effect would be minor, however, because the boat ramps would be unusable mostly in lower use months, such as September and October.

In dry hydrologic conditions, operation model results show that boat ramps could be less than usable throughout the recreation season under all alternatives.

iv. Lahontan Reservoir

Operations model results show that average surface acres are about the same under TROA as under No Action and current conditions in all three hydrologic conditions; as a result, the number of recreationists likely would be about the same. Boat ramp usability is the same as under No Action and current conditions.

5. Mitigation

No mitigation would be required because no significant effects would occur under any of the alternatives. However, in periods when reservoir elevations fall below the bottom of the boat ramps and the ramps become unusable, the length of the existing boat ramps could be extended where topography allows. If extending the existing ramp is impractical due to terrain or other environmental concerns, it may be possible to relocate the boat ramp to another location.

D. Stream-Based Recreation

1. Method of Analysis

Suitability of flows for fly fishing, spin/lure/bait fishing, rafting and kayaking were quantified by determining the number of months with desired flows for each activity during the recreation season.

Desired flows were established through interviews and statistical surveys of actual river users engaged in each particular activity (Auckerman, et al., 1999). Note, however, that users may still elect to participate in a given activity even if flows are not within desired ranges. In other words, anglers may still fish although flows are either low or high. The nature of water-based recreation is that as long as there is water, some percentage of the user population will still participate in that activity. The highly engaged enthusiast may elect to go somewhere else if elevations are too high or too low during the 7-month recreation season, but the casual user may still participate in the activity, if not for the particular experience they are seeking, then for some other reason, such as enjoying the scenic setting. For this reason, the model results should not be viewed as absolutes but rather indicators of trends of recreational use.

River users were asked to identify flows that were higher than desired, desired, or were less than desired (in cfs) for their activity. These survey data were then averaged to determine flow preferences. These averaged flows were then compared to flows for reaches of river and streams (map 3.1) generated by the operations model for three hydrologic conditions—wet, median, and dry (i.e., hydrologic conditions with 10-, 50- and 90-percent exceedences)—for the 7-month recreation season under current conditions, No Action, LWSA, and TROA.

The following shows the percentage of survey respondents that indicated either high or low flows would prevent them from using the river.

Activity	Percentage of river users who said "low flow would stop use"	Percentage of river users who said "high flow would stop use"
Fly fishing	24	76
Spin/lure/bait fishing	34	66
Kayaking	92	8
Rafting	84	16

2. Threshold of Significance

For stream-based recreation, an effect was considered significant when flows (either high or low) would prevent participants from pursuing their activity.

3. Model Results

Tables 3.78 through 3.81 presents operations model results for the number of months various flows occur in the 7-month recreation season in wet, median, and dry hydrologic conditions under current conditions, No Action, LWSA, and TROA. The relation of the flows to desired flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking is shown. Note that that reservoirs are not operated to achieve desired flows unless they coincide with Floriston Rates; achievement under any alternative or current conditions would be happenstance.

Table 3.78.—Fly fishing
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Donner Creek: Donner Lake to Truckee River	Wet	>	5	5	5	4
		=	0	0	0	0
		<	2	2	2	3
	Median	>	1	1	1	1
		=	2	2	2	2
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Prosser Creek: Prosser Creek Reservoir to Truckee River	Wet	>	6	6	6	6
		=	0	0	0	1
		<	1	1	1	0
	Median	>	5	4	4	4
		=	0	1	1	2
		<	2	2	2	1
	Dry	>	0	0	0	0
		=	0	0	1	0
		<	7	7	6	7
Independence Creek: Independence Lake to Little Truckee River	Wet	>	Not applicable	Not applicable	Not applicable	Not applicable
		=				
		<				
	Median	>	Not applicable	Not applicable	Not applicable	Not applicable
		=				
		<				
	Dry	>	Not applicable	Not applicable	Not applicable	Not applicable
		=				
		<				
Little Truckee River: Independence Creek to Stampede Reservoir	Wet	>	2	2	2	2
		=	2	2	2	2
		<	3	3	3	3
	Median	>	0	0	0	0
		=	2	2	2	2
		<	5	5	5	5
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Little Truckee River: Stampede Reservoir to Boca Reservoir	Wet	>	5	4	4	1
		=	1	2	2	4
		<	1	1	1	2
	Median	>	3	3	3	1
		=	1	2	2	4
		<	3	2	2	2
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

Table 3.78.—Fly fishing
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Truckee River: Lake Tahoe to Donner Creek	Wet	>	1	1	1	1
		=	5	5	5	2
		<	1	1	1	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Donner Creek to Little Truckee River confluence	Wet	>	4	4	4	4
		=	2	2	2	0
		<	1	1	1	3
	Median	>	3	3	3	3
		=	0	0	0	0
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Little Truckee River to State line	Wet	>	7	7	7	6
		=	0	0	0	1
		<	0	0	0	0
	Median	>	6	6	6	5
		=	1	1	1	2
		<	0	0	0	0
	Dry	>	4	5	4	3
		=	1	1	1	2
		<	2	1	2	2
Trophy	Wet	>	4	5	5	4
		=	3	2	2	2
		<	0	0	0	1
	Median	>	3	3	3	3
		=	2	3	3	2
		<	2	1	1	2
	Dry	>	1	3	1	1
		=	3	3	3	3
		<	3	1	3	3
Mayberry, Oxbow, Spice	Wet	>	3	3	3	3
		=	2	2	2	2
		<	2	2	2	2
	Median	>	3	2	2	2
		=	0	1	1	1
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	1	1	1	1
		<	6	6	6	6
Lockwood, Nixon	Wet	>	3	3	3	3
		=	0	0	0	0
		<	4	4	4	4
	Median	>	0	0	0	0
		=	1	1	1	1
		<	6	6	6	6
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

Table 3.79.—Spin/lure/bait fishing
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Donner Creek: Donner Lake to Truckee River	Wet	>	4	6	5	4
		=	1	0	0	0
		<	2	1	2	3
	Median	>	1	1	1	1
		=	2	2	2	2
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Prosser Creek: Prosser Creek Reservoir to Truckee River	Wet	>	6	6	6	6
		=	0	0	0	1
		<	1	1	1	0
	Median	>	5	4	4	4
		=	0	1	1	2
		<	2	2	2	1
	Dry	>	0	0	0	0
		=	0	1	1	0
		<	7	6	6	7
Independence Creek: Independence Lake to Little Truckee River	Wet	>				
		=	Not applicable	Not applicable	Not applicable	Not applicable
		<				
	Median	>				
		=	Not applicable	Not applicable	Not applicable	Not applicable
		<				
	Dry	>				
		=	Not applicable	Not applicable	Not applicable	Not applicable
		<				
Little Truckee River: Independence Creek to Stampede Reservoir	Wet	>	4	4	4	4
		=	2	2	2	2
		<	1	1	1	1
	Median	>	3	3	3	3
		=	1	1	1	1
		<	3	3	3	3
	Dry	>	2	2	2	2
		=	1	1	1	1
		<	4	4	4	4
Little Truckee River: Stampede Reservoir to Boca Reservoir	Wet	>	3	3	3	2
		=	2	2	2	3
		<	2	2	2	2
	Median	>	0	0	0	0
		=	3	3	3	3
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Lake Tahoe to Donner Creek	Wet	>	0	0	0	1
		=	6	6	6	2
		<	1	1	1	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

Table 3.79.—Spin/lure/bait fishing
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Truckee River: Donner Creek to Little Truckee River confluence	Wet	>	3	3	3	3
		=	3	3	3	1
		<	1	1	1	3
	Median	>	0	0	0	1
		=	3	3	3	2
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Little Truckee River to State line	Wet	>	4	4	4	4
		=	3	3	3	3
		<	0	0	0	0
	Median	>	3	3	3	3
		=	4	4	4	4
		<	0	0	0	0
	Dry	>	0	0	0	0
		=	5	5	5	5
		<	2	2	2	2
Trophy	Wet	>	6	5	5	5
		=	1	2	2	1
		<	0	0	0	1
	Median	>	3	3	3	3
		=	2	3	3	2
		<	2	1	1	2
	Dry	>	1	1	2	1
		=	2	2	2	2
		<	4	4	3	4
Mayberry, Oxbow, Spice	Wet	>	3	3	3	3
		=	2	2	2	1
		<	2	2	2	3
	Median	>	3	2	2	2
		=	0	1	1	1
		<	4	4	4	4
	Dry	>	0	0	0	0
		=	1	0	0	0
		<	6	7	7	7
Lockwood, Nixon	Wet	>	1	1	1	1
		=	2	2	2	2
		<	4	4	4	4
	Median	>	0	0	0	0
		=	1	1	1	1
		<	6	6	6	6
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

Table 3.80.—Rafting
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Truckee River: Lake Tahoe to Donner Creek	Wet	>	0	0	0	0
		=	6	6	6	3
		<	1	1	1	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Donner Creek to Little Truckee River	Wet	>	3	3	3	3
		=	0	0	0	0
		<	4	4	4	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Little Truckee River to State line	Wet	>	3	3	3	3
		=	1	0	0	0
		<	3	4	4	4
	Median	>	1	1	1	1
		=	1	1	1	1
		<	5	5	5	5
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Trophy	Wet	>	0	0	0	0
		=	3	3	3	3
		<	4	4	4	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Mayberry, Oxbow, Spice	Wet	>	0	0	0	0
		=	2	2	2	3
		<	5	5	5	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Lockwood, Nixon	Wet	>	1	1	1	1
		=	2	2	2	2
		<	4	4	4	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

Table 3.81.—Kayaking
Number of months various flows occur in 7-month recreation season

River/tributary reach	Hydrologic condition	Relation to desired flows	Current conditions	No Action	LWSA	TROA
Truckee River: Truckee River: Lake Tahoe to Donner Creek	Wet	>	0	0	0	0
		=	6	6	6	3
		<	1	1	1	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Donner Creek to Little Truckee River	Wet	>	3	3	3	3
		=	0	0	0	0
		<	4	4	4	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Truckee River: Little Truckee River to State line	Wet	>	3	3	3	3
		=	0	0	0	0
		<	4	4	4	4
	Median	>	0	0	0	0
		=	2	2	2	2
		<	5	5	5	5
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Trophy	Wet	>	0	0	0	0
		=	3	3	3	3
		<	4	4	4	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Mayberry, Oxbow, Spice	Wet	>	0	0	0	0
		=	2	2	2	3
		<	5	5	5	4
	Median	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7
Lockwood, Nixon	Wet	>	1	1	1	1
		=	2	2	2	2
		<	4	4	4	4
	Median	>	0	0	0	0
		=	1	1	1	1
		<	6	6	6	6
	Dry	>	0	0	0	0
		=	0	0	0	0
		<	7	7	7	7

4. Evaluation of Effects

a. No Action

i. Donner Creek: Donner Lake Dam to Truckee River

Operations model results show the same flows for fly fishing under No Action and current conditions. Desired flows occur only in median hydrologic conditions; flows are eithergreater or less than desired throughout the recreation season in all other hydrologic conditions. However, as discussed previously, fly fishing is a minor activity on this stream.

Flows for spin/lure/bait fishing are the same in the median and dry hydrologic conditions under No Action and current conditions. In wet hydrologic conditions, desired flows do not occur under No Action, compared to one month under current conditions. Because the majority of anglers are generalists who are engaged by other aspects of the overall recreation experience and for whom angling may be secondary to camping, there would be no effect.

ii. Prosser Creek: Prosser Creek Reservoir to Truckee River

Operations model results show the same flows for fly fishing under No Action and current conditions in wet and dry hydrologic conditions. In median hydrologic conditions, one month of desired flows occurs under No Action compared to no months under current conditions. The effect on fly fishing would be insignificant.

The same number of months with desired flows for spin/lure/bait fishing occurs in wet hydrologic conditions under No Action and current conditions. In median and dry hydrologic conditions, one month with desired flows occurs under No Action compared to no months under current conditions. However, because of the relatively small numbers of fly anglers in this creek, the overall effect on recreation would be insignificant.

iii. Independence Creek: Independence Lake to Little Truckee River

No data are available to determine desired flows for fishing in this reach.

iv. Little Truckee River: Independence Creek to Stampede Reservoir

Operations model results show the same flows for flying fishing under No Action and current conditions. In both wet and median hydrologic conditions, desired flows occur 2 months; less-than-desired flows occur more frequently than greater-than-desired flows, which could displace fly anglers to other streams and creeks offering with more suitable flows. However, an insignificant number of anglers likely would be displaced, because many would continue to pursue their sport during non-desired flows to enjoy other aspects of the experience, such as refining casting skills, enjoying solitude, and viewing scenic vistas.

Flows for spin/lure/bait fishing also are the same under current conditions and No Action: desired flows occur 2 months in wet hydrologic conditions, and 1 month in median hydrologic conditions. More spin/lure/bait anglers would be displaced by non-desired flows than fly anglers, which could result in crowding.

v. Little Truckee River: Stampede Reservoir to Boca Reservoir

Operations model results show 1 more month with desired flows for fly fishing under No Action (total of 2 months) than under current conditions in both wet and median hydrologic conditions, and no desired flows in dry hydrologic conditions under either No Action or current conditions. In all hydrologic conditions, when flows are less than or greater than desired, fly anglers could be displaced to other streams and creeks offering with suitable flows. However, as in the Little Truckee River from Independence Creek to Stampede Reservoir, an insignificant number of anglers likely would be displaced, because many would continue to pursue their sport during non-desired flows to enjoy other aspects of the experience, such as refining casting skills, enjoying solitude, and viewing scenic vistas, which would be especially true in light of the abundance of open meadows that offer excellent terrain for casting and enjoying scenic vistas.

Flows for spin/lure/bait fishing are the same under No Action and current conditions: desired flows occur in 2 months in wet hydrologic conditions and in 3 months in median hydrologic conditions. Desired flows do not occur in dry hydrologic conditions. Consequently, spin/lure/bait anglers could be displaced to other locations with more suitable flows, which could result in crowding and excessive pressure on those areas.

vi. Truckee River: Lake Tahoe to Donner Creek

Operations model results show the same flows for fly fishing under No Action and current conditions: 5 months with desired flows in wet hydrologic conditions and less-than-desired flows throughout the recreation season in median and dry hydrologic conditions. These less-than-desired flows could diminish the fly fishing experience. However, because of the multiple-use nature of this reach of river and the numbers of recreationists, fly anglers here are, for the most part, not the highly skilled and dedicated practitioners of the sport. Therefore, fewer fly anglers would likely be displaced than in other, less popular, reaches.

Flows are the same for spin/lure/bait fishing under No Action and current conditions: 6 months with desired flows in wet hydrologic conditions and less-than-desired flows throughout the recreation season in median and dry hydrologic conditions.

Flows for rafting and kayaking are similar to those for fly and spin/lure/bait fishing: 6 months with desired flows in wet hydrologic conditions and no months with desired flows in median and dry hydrologic conditions under both No Action and current conditions. In general, flows are less than preferred, which could adversely affect commercial rafting companies, prompting them to shift operations to other areas with better flows or cease operations.

vii. Truckee River: Donner Creek to Little Truckee River Confluence

Operations model results show that flows for fly fishing are the same under No Action and current conditions. Conditions would be the best in wet hydrologic conditions, with 2 months of desired flows, compared to no months with desired flows in median and dry hydrologic conditions. Because of the many fish in the river, together with favorable terrain, open banks for casting, and nice scenery, few anglers would likely move because they would continue to enjoy other aspects of the experience in this reach.

Flows for spin/lure/bait fishing are the same under No Action and current conditions, including 3 months with desired flows in wet and median hydrologic conditions, or almost half of the recreation season. Thus, few anglers would likely be displaced to other areas.

No desired flows for rafting and kayaking occur under either No Action or current conditions in any hydrologic condition, although operations model results show 3 months with greater-than-desired flows in wet hydrologic conditions under both No Action and current conditions. As result, several of the rapids could become Class III whitewater, which could cause more accidents and dangerous conditions for less practiced boaters. In median and dry hydrologic conditions, flows are less than preferred, thus making the river easier for novice and intermediate rafters and kayakers. More advanced boaters could be displaced to other areas with higher flows; however, this displacement could be offset by lower flows that could attract more beginning and intermediate users.

viii. Truckee River: Little Truckee River to State Line

Operations model results show that flows are the same for fly fishing under No Action and current conditions. Flows are consistently greater-than-desired in wet hydrologic conditions. Flows are also greater than desired in median hydrologic conditions, except for 1 month with desired flows. In dry hydrologic conditions, 1 month fewer with less-than-desired flows occurs under No Action than under current conditions. Fly anglers could remain or find other places to fish with more favorable flows. However, minimal displacement would occur because most anglers are likely seeking other recreational attributes that complement the fishing experience, such as scenic viewing, picnicking, or camping, that would not be affected by high flows.

Spin/lure/bait anglers would fare much better than fly anglers in this reach of river. Again, operation model results show the same flows under both No Action and current conditions: desired flows occur 3 months in wet hydrologic conditions; 4 months in median hydrologic conditions, and 5 months in dry hydrologic conditions. Thus, overall, flows for spin/lure/bait anglers would be relatively favorable under either current conditions or No Action.

Flows for rafting differ between No Action and current conditions only in wet hydrologic conditions, with 1 fewer month with desired flows under No Action than under current conditions. In median and dry hydrologic conditions, flows are less than desired almost throughout the recreation season, which could adversely affect the recreation experience by lowering the skills required and making the experience more passive. Experienced rafters could look for more favorable flows elsewhere.

Flows for kayaking are the same under both No Action and current conditions. Flows in median hydrologic conditions are most favorable for kayaking, with 2 months with desired flows. Flows are either greater than desired or less than desired in wet hydrologic conditions and are consistently less than preferred in dry hydrologic conditions. The effect on kayaking would be the same as for rafting in this reach of river.

ix. Trophy

Operations model results show that in this reach, flows for fly fishing differ somewhat between No Action and current conditions, with 1 fewer month with desired flows under No Action than under current conditions in wet hydrologic conditions and 1 more month (total of 3 months) in median hydrologic conditions. A total of 3 months with desired flows occur under both current conditions and No Action in dry hydrologic conditions. Less-than-desired river flows could displace a percentage of fly anglers.

For spin/lure/bait fishing, operations model results show the following : 1 more month with desired flows under No Action than under current conditions in wet and median hydrologic conditions (total of 3 and 2 months, respectively) and 2 months with desired flows in dry hydrologic conditions under both No Action and current conditions. Less-than-desired flows would probably not displace as many spin/lure/bait anglers as fly anglers because of many deep pools that would retain sufficient water for spin/lure/bait angling despite less-than-desired flows.

Flows for both rafting and kayaking are the same under No Action and current conditions: 3 months with desired flows in wet hydrologic conditions and less-than-desired flows in median and dry hydrologic conditions. Less-than-desired flows could serve to displace commercial rafting/kayaking companies and advanced-to-expert enthusiasts who equate higher flows with the challenge and skill application essential to the quality of the experience.

x. Mayberry, Oxbow, Spice

Operations model results show 1 month with desired flows for fly fishing in median hydrologic conditions under No Action compared to no desired flows under current conditions and no desired flows under either No Action or current conditions in wet and dry hydrologic conditions. However, because of the relatively few fly anglers, these flows would have an insignificant effect on the sport.

Desired flows for spin/lure/bait fishing occur 2 months in wet hydrologic conditions under both current conditions and No Action; however, less-than-desired flows occur under No Action, while greater-than-desired flows occur throughout the remainder of the recreation season under current conditions. In median hydrologic conditions, flows are either greater than preferred or less than preferred under current conditions, compared to 1 month with desired flows under No Action. In dry hydrologic conditions, no months with desired flows occur under No Action, compared to 1 month under current conditions. However, because most of the fishing in this reach of river is supplemented by stocked fish, flow levels are less important because stocked fish are easier to catch than wild fish and will more readily strike lures or bait under differing conditions. Therefore, success rates for spin/lure/bait anglers should be higher, regardless of flows.

Flows for rafting and kayaking are the same under No Action and current conditions: desired flows only occur in wet hydrologic conditions (2 months); flows are less than preferred for the rest of the season. Less-than-desired flows also occur throughout the recreation season in median and dry hydrologic conditions, which could have the same effects as discussed under “Trophy.”

xi. Lockwood, Nixon

Operations model results show that flows for fly fishing are the same under No Action and current conditions. Desired flows only occur in median hydrologic conditions and only in 1 month. Greater-than-desired flows only occur in wet hydrologic conditions, and less-than-desired flows occur the remainder of the time. These flows have minor significance, however, because of the relatively few fly anglers on this reach of river.

Likewise, flows for spin/lure/bait fishing are the same under No Action and current conditions. Desired flows only occur in wet (2 months) and median hydrologic conditions. Less-than-desired flow occur the remainder of the time. Again, these model results are of minor significance because of the relatively few spin/lure/bait anglers on this reach.

Flows for both rafting and kayaking are the same under No Action and current conditions.

b. LWSA

i. Donner Creek: Donner Lake to Truckee River

Operations model results show that flows for fly fishing are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

In wet hydrologic conditions, no desired flows for spin/lure/bait fishing occur under LWSA (or No Action) compared to 1 month under current conditions. Flows are the same in median and dry hydrologic conditions under LWSA, No Action, and current conditions. Effects would be the same as under No Action.

ii. Prosser Creek: Prosser Creek Reservoir to Truckee River

Operations model results show that flows for fly fishing are the same under LWSA, No Action and current conditions, and effects would be the same as under No Action.

Desired flows for spin/lure/bait fishing are the same in wet hydrologic conditions under LWSA, No Action, and current conditions. In median and dry hydrologic conditions, 1 month with desired flows occurs under LWSA and No Action compared to no desired flows under current conditions. However, because of the relatively few spin/lure/bait anglers, the effect would be insignificant.

iii. Independence Creek: Independence Lake to Little Truckee River

No data are available to determine desired flows for fishing in this reach.

iv. Little Truckee River: Independence Creek to Stampede Reservoir

Operations model results show that flows for fly fishing are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows for spin/lure/bait fishing also are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

v. Little Truckee River: Stampede Reservoir to Boca Reservoir

Operations model results show 1 more month with desired flows for fly fishing under LWSA and No Action than under current conditions in both wet and median hydrologic conditions and no desired flows in dry hydrologic conditions under LWSA, No Action, and current conditions. Effects would be the same as under No Action.

Flows for spin/lure/bait fishing are the same under LWSA, No Action and current conditions, and effects would be the same as under No Action.

vi. Truckee River: Lake Tahoe to Donner Creek

Operations model results show that flows for fly fishing are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows for spin/lure/bait fishing also are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows for rafting and kayaking also are the same under LWSA, No Action, and current conditions. Effects would be the same as under No Action.

vii. Truckee River: Donner Creek to Little Truckee River

Operations model results show that flows for fly fishing are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows for spin/lure/bait fishing also are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows for kayaking and rafting also are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

viii. Truckee River: Little Truckee River to State Line

Operations model results shows that flows for fly fishing are the same under LWSA, No Action, and current conditions in wet and median hydrologic conditions. In dry hydrologic conditions, 4 months with greater-than-desired flows occur under LWSA and current conditions compared to 5 months under No Action.

Flows for spin/lure/bait fishing are the same under LWSA, No Action, and current conditions, and effects would be the same as under No Action.

Flows and the subsequent effects on rafting are the same under LWSA as under No Action. Flows for kayaking are the same as under No Action and current conditions, and effects would be the same as under No Action.

ix. Trophy

Operations model results show the flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking are the same under LWSA as under No Action, and effects would be the same as under No Action.

x. Mayberry, Oxbow, Spice

Flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking are the same under LWSA as under No Action, and effects would be the same as under No Action.

xi. Lockwood, Nixon

Operations model results show that flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking are the same under LWSA as under No Action and current conditions, and effects would be the same as under No Action.

c. TROA

i. Donner Creek: Donner Lake to Truckee River

Operations model results show that flows for fly fishing are similar under TROA, No Action, and current conditions and effects would be the same as under No Action.

Flows for spin/lure/bait fishing are the same under LWSA as under No Action, and effects would be the same as under No Action.

ii. Prosser Creek: Prosser Creek Reservoir to Truckee River

Operations model results show 1 month with desired flows in wet hydrologic conditions under TROA compared to no desired flows under either No Action or current conditions, and 2 months with desired flows in median hydrologic conditions, compared to 1 month under No Action and no desired flows under current conditions. Flows in dry hydrologic conditions are the same under TROA, No Action, and current conditions. Overall, effects would be the same as under No Action.

One month with desired flows for spin/lure/bait fishing occurs in wet hydrologic conditions under TROA, compared to no desired flows under either No Action or current conditions. In median hydrologic conditions, 2 months with desired flows occur under TROA, compared to 1 month under No Action and no desired flows under current conditions. As a result, flows for spin/lure/bait fishing in this reach are best under TROA. However, because of the relatively few fly anglers, this difference between the alternatives and current conditions is relatively insignificant.

iii. Independence Creek: Independence Lake to Little Truckee River

No data are available to determine desired flows for fishing in this reach.

iv. Little Truckee River: Independence Creek to Stampede Reservoir

Operations model results show that flows for fly fishing and spin/lure/bait fishing also are the same under TROA as under No Action and current conditions, and effects would be the same as under No Action.

v. Little Truckee River: Stampede Reservoir to Boca Reservoir

Operations model results show 2 more months with desired flows for fly fishing under TROA (total of 4 months) than under No Action and 3 more months than under current conditions in both wet and median hydrologic conditions. No desired flows occur in dry hydrologic conditions under TROA, No Action, or current conditions. In both wet and median hydrologic conditions, conditions under TROA would clearly be more favorable for fly anglers.

One more month with desired flows for spin/lure/bait fishing occurs in wet hydrologic conditions under TROA (total of 3 months) than under No Action or current conditions. Flows in median and dry hydrologic conditions are the same under TROA as under No Action and current conditions. Overall, effects would be the same as under No Action.

vi. Truckee River: Lake Tahoe to Donner Creek

Operations model results show that flows for fly fishing are the same under TROA as under No Action and current conditions, and effects would be the same as under No Action. Flows for spin/lure/bait fishing vary only in wet hydrologic conditions under TROA, No Action, or current conditions, when 4 fewer months of desired flows (total of 2 months) occur under TROA than under No Action or current conditions. Effects would be the same as under No Action.

Three fewer months with desired flows for rafting and kayaking occur under TROA than under No Action or current conditions (total of 6 months each). Desired flows are the same in both median and dry hydrologic conditions under TROA, No Action, and current conditions. Effects would be the same as under No Action.

vii. Truckee River: Donner Creek to Little Truckee River

Operations model results show several minor differences in flows for fly fishing under TROA, No Action, and current conditions in wet and median hydrologic conditions. In wet hydrologic conditions, no desired flows occur under TROA, compared to 2 months under both No Action and current conditions. Flows are consistently less than preferred under TROA. In median and dry hydrologic conditions, no desired flows occur under TROA, No Action, or current conditions. Overall, effects would be the same as under No Action.

For spin/lure/bait fishing, 3 fewer months with desired flows occur (total of 1 month) in wet hydrologic hydrologic conditions and 1 fewer month with desired flows (total of 2 months) occurs in median hydrologic conditions under TROA than either current conditions or No Action. Flows are less than preferred throughout the recreation season under TROA, No Action, and current conditions. Overall effects would be the same as under No Action.

Flows for rafting and kayaking are the same under TROA, No Action, and current conditions, and effects would be the same as under No Action.

viii. Truckee River: Little Truckee River to State Line

Operations model results show that flows for fly fishing differ under TROA, No Action, and current conditions. In wet and median hydrologic conditions, 1 month of desired flows occurs under TROA compared to no desired flows under either No Action or current conditions. In dry hydrologic conditions, 2 months with desired flows occurs under TROA compared to 1 month under No Action and current conditions. Flows that are not preferred range tend to be greater-than-desired flows. Effects would be the same as under No Action.

Flows for spin/lure/bait fishing also are the same under TROA as under No Action and current conditions, and effects would be the same as under No Action.

Flows for rafting vary under TROA, No Action, and current conditions in wet and median hydrologic conditions. In wet hydrologic conditions, no desired flow occurs under TROA and No Action compared to 1 month under current conditions. In median hydrologic conditions, 2 months with desired flows occur under TROA, compared to 1 month under both No Action and current conditions. Effects generally would be the same as under No Action, except that flows could be more favorable under TROA in median hydrologic conditions.

Flows for kayaking are the same under TROA, No Action, and current conditions, and effects would be the same as under No Action.

ix. Trophy

Operations model results show that flows for fly fishing vary somewhat under TROA, No Action, and current conditions. In wet hydrologic conditions, under TROA, 1 fewer month with desired flows occurs than under No Action and 2 fewer months occur than under current conditions. In median hydrologic conditions, 1 fewer month with desired flows occurs under TROA and current conditions (total of 3 months) than under No Action. Three months with desired flows occur in dry hydrologic conditions under TROA, No Action, and current conditions. Two more months with less-than-desired flows occur under TROA and current conditions than under No Action. Overall, flows would be less preferable fly anglers in this reach under TROA than under No Action and current conditions, which could serve to displace a percentage of fly anglers.

Flows for spin/lure/bait fishing also vary under TROA, No Action, and current conditions. In wet and median hydrologic conditions, 1 fewer month with desired flows occurs under TROA and current conditions than under No Action. In dry hydrologic conditions, 2 months with desired flows occur under TROA, No Action, and current conditions. When flows are less than preferable, spin/lure/bait anglers could voluntarily seek out other streams and reaches of the river with more favorable flows, acting to concentrate anglers in those locations. This concentration could result in overuse of parking areas, facilities, and access points. Less-than-desired flows probably would not displace as many spin/lure/bait anglers as fly anglers because of the presence of many deep pools that would retain sufficient water for spin/lure/bait angling despite less-than-desired flows.

Flows for rafting and kayaking are the same under TROA, No Action, and current conditions, and effects would be the same as under No Action.

x. Mayberry, Oxbow, Spice

Operations model results show one more month with desired flows (total of 1 month) for fly fishing in median hydrologic conditions under both TROA and No Action. In wet and dry hydrologic conditions, no desired flows occur under TROA, No Action, or current conditions. However, because of the relatively few fly anglers, greater-than-desired flows (wet hydrologic conditions) and less-than-desired flows would have an insignificant impact.

Flows for spin/lure/bait fishing vary somewhat in wet hydrologic conditions, with 1 fewer month (total of 1 month) with desired flows under TROA than under No Action and current conditions. No desired flows occur in median hydrologic conditions, no desired flows occur under TROA, No Action, or current conditions. In dry hydrologic conditions, no desired flows occur under current conditions compared to 1 month under current conditions. Effects would be the same as under No Action.

Flows for rafting and kayaking are the same under TROA, No Action, and current conditions, except that 3 months with desired flows occurs in wet hydrologic conditions under TROA compared to 2 months under No Action and current conditions. Effects would be the same as under No Action.

xi. Lockwood, Nixon

Operations model results show that flows for fly fishing, spin/lure/bait fishing, rafting, and kayaking are the same under TROA as under No Action and current conditions, and effects would be the same as under No Action.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives. This does not mean that river users would not be affected. As river conditions change, some users would move to areas with more desirable flows for their activity. However, these users could be replaced by other users who may find the new flows more conducive for their type of recreation activity. In other words, in stream-based recreation, there is no "one size fits all." However, considering that significant effects occur when all river recreationists are prevented from pursuing stream based activities, there are no significant effects.

ECONOMIC ENVIRONMENT

I. AFFECTED ENVIRONMENT

This section provides an overview of the current economic environment of the study area and describes aspects of the study area's economy that could be affected by modifying operations of Truckee River reservoirs and changing the allocation of water use in the Truckee River basin.

A. Current Economic Environment

1. California

The California portion of the study area includes the eastern parts of El Dorado, Nevada, and Placer Counties and the southeastern part of Sierra County. Population centers include South Lake Tahoe (El Dorado), Truckee (Nevada), and Tahoe City (Placer). The economies of the western parts (outside the study area) and eastern parts (inside the study area) of these counties vary greatly. Most of the population (88 percent) resides and is employed in the western parts of the counties, primarily because of the influence of metropolitan Sacramento and the presence of large manufacturing, service, and agricultural sectors. The remaining 12 percent resides within the study area.

The Lake Tahoe tourist industry is an important contributor to the economy of eastern El Dorado and Placer Counties, which contain the western portion of the lake. Approximately 78 percent of the total employment in the California portion of the study area is located in the eastern side of these two counties. The industry includes lake-based recreation in the summer and skiing and snowmobiling in the winter, which generate employment and income in the retail trade and service sectors of the economy. Residents of these counties are also employed by the hotel, gaming, and recreation industry on the Nevada side of South Lake Tahoe.

In Nevada County, tourism, skiing, and recreation on Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs and along the Truckee River generate income and employment in the retail trade and service sectors. In the Truckee-Donner area, important economic sectors are retail trade, services, real estate, and construction.

Most of Sierra County is rural and contains Tahoe and Toiyabe National Forests. The government sector employs about 40 percent of workers in the entire county, mostly in State and local government. Logging and sawmill operations and recreational activities also generate some employment and income.

2. Nevada

The Nevada portion of the study area includes parts of Lyon, Storey, Washoe and Churchill Counties and Carson City. (Carson City is not analyzed). Population centers include Fernley (Lyon) and Reno-Sparks, Wadsworth, Nixon, and Sutcliffe (Washoe). The agricultural community of Fallon is located in Churchill County in the lower Carson River basin.

The hotel, gaming, and recreation industry is also important to the economies of the Nevada counties within the study area. Agriculture, government, and construction and mining also contribute to the economy.

The economy of Lyon County is based mostly on manufacturing, services, and agriculture. The county is noted for its alfalfa and beef cattle production. The portion of the county in the study area is Fernley and a portion of the Truckee Division of the Newlands Project, which is located in the northwestern portion of the county. Fernley has been growing in the past decade due to its proximity to Truckee Meadows.

Washoe County, which contains the northeast portion of Lake Tahoe, Pyramid Lake, and the rapidly growing Truckee Meadows, is the most populous and economically diverse county in the study area. This county’s economy has expanded over the past 20 years, because of growth in the hotel and casino industry, warehousing, and manufacturing. A majority of the study area's employment (84 percent) occurs in Truckee Meadows. Important economic sectors are service, manufacturing, retail trade, and State and local government. Expenditures related to the recreational activities at Pyramid Lake also contribute to local economy. Irrigated lands in Washoe County are located within Truckee Meadows.

Churchill County is located east of Storey and Lyon Counties. In the past, agriculture and mining were the dominant economic sectors in the county (MacDiarmid, et. al, 1994). In the past decade, however, the county’s economic structure has become more diversified and is now mostly based on services, government, trade, manufacturing, and agriculture (Darden, et. al, 2003). Naval Air Station Fallon is a major source of employment and income. An estimated 2,900 county residents are employed directly or indirectly by service sector employment attributed to the presence of NASF (Churchill County Economic Development Authority, 2003). In the Fallon area, there are plans for development of industrial/business park to accommodate new businesses locating in the area. Fallon and surrounding areas are also attracting retirees to the area.

Churchill County includes a major portion of the Newlands Project’s Truckee Division and all of the Carson Division. The project generates most of the agricultural production in Churchill County. The Truckee River provides a portion of the project’s irrigated water supply via the Truckee Canal. Alfalfa and livestock are primary agricultural commodities produced in the area.

From 1987 to 1997, irrigated acreage in Churchill County declined by approximately 24 percent (1997 Census of Agriculture, Nevada). The decline is most probably due to changing agricultural markets and the increasing demand for nonagricultural water in the area. In the future, water right purchases under the Truckee River Water Quality Settlement

Agreement, Nevada State AB 380 program, Water Rights Acquisition Program for Lahontan Valley wetlands, and by private developers will continue the trend of declining agricultural water rights and irrigated agriculture in Churchill County.

B. Employment and Total Income

Table 3.82 presents employment and total income for those parts of the counties within the study area. Data were derived from baseline data collected for the regional economic model. Employment and income associated with recreation expenditures under current conditions, No Action, LWSA, and TROA are discussed under "Recreation Expenditures."

Table 3.82.—Employment and income in the study area, 1995[1]

	Total income (million $)	Total employment (full- and part-time jobs)
Portions of California counties		
El Dorado	167.1	8,685
Nevada	72.4	3,540
Placer	101.4	4,520
Sierra	3.1	158
California total	$ 344.0	14,908
Nevada counties		
Churchill	148.8	8,168
Lyon	166.0	8,765
Washoe	4,135.5	182,829
Nevada total	$4,450.3	199,762
Total	$ 267.4	13,285

Source: University of Nevada, Reno, Technical Report UCED 98/99-04
[1] Only those portions of the California counties within the study area are included in this analysis.

Employment is based on the number of full- and part-time jobs within the study area. Total income is defined as personal income, which is based on wages, salaries, other income, dividends, interest, rent, and government transfer payments.

1. California

Major employment sectors (more than 10 percent of total employment) in the California portion of the study area are construction (13 percent); wholesale and retail trade (19 percent); finance, insurance, and real estate (10 percent); and services (20 percent). El Dorado County reported the most full- and part-time nonagricultural jobs (8,579), followed by Placer County (4,475), Nevada County (3,456), and Sierra County (155). The estimated total income in 1995 for those portions of the California counties within the study area was $344 million.

2. Nevada

Major employment sectors in the Nevada portion of the study area are hotels, gaming, and recreation (20 percent); services (19 percent); wholesale and retail trade (18 percent); and State and local government (11 percent). Agriculture, construction, manufacturing, and mining also contribute to the economy. Washoe County reported the most full- and part-time nonagricultural jobs (180,764), followed by Lyon County (8,063), and Churchill County (7,415). In 1995, estimated total income for those portions of the Nevada counties within the study area was $4,450.3 million.

C. Agricultural and M&I Water Use

Current agricultural and M&I water use in the study area are discussed in “Water Resources.” In the future, TMWA is expected to continue to acquire agricultural water rights in Truckee Meadows to meet increased M&I demands.

Current agricultural water rights are about 27,937 acre-feet per year in Truckee Meadows and about 13,885 acre feet per year in the Truckee Division. For Truckee Meadows, most of these rights are of small acreage and if the water is used, it is mostly for pasture. The primary crops grown in the study area are alfalfa hay, other hay and pasture. Livestock and dairy production also occur in the area. Total gross agricultural output is approximately $20.6 million. Total employment and personal income, based on 1995 data for the agricultural sector, are approximately 367 jobs and $6 million, respectively. As of 2002, TMWA dedicated 57,170 acre-feet of agricultural water rights for M&I use. Current M&I demand in Truckee Meadows for Truckee River surface water is 83,140 acre-feet per year.

II. Environmental Consequences

A. Introduction

Modifying operations of Truckee River reservoirs could affect the study area economy by: (1) changing lake and reservoir storage, (2) changing the quality, quantity, timing, and duration of flows (3) reducing hydropower generation along the Truckee River and (4) affecting groundwater usage in the Truckee Meadows area.

Changes in reservoir storage could affect recreation visitation and, thus, affect recreation expenditures. The change in recreation expenditures could “ripple through” the economy, resulting in changes to recreation-related employment and income. Reducing hydropower generation from plants along the river could affect associated revenues. The hydropower generation along the river is classified as “nonfirm baseload power,” which is low cost to produce but is not a reliable source because of the variability of Truckee River flows.

Allowing for different storage amounts of M&I and agricultural water in the Truckee River basin could also affect the study area economy. Future water demand in urban areas will require the purchase of agricultural water rights and storage to be used for M&I purposes.

TROA would provide the flexibility to store and release water for these two uses in the upper basin reservoirs. This flexibility in storage would allow for reallocation of water from agriculture to M&I water use. The trend of declining agricultural water use to greater M&I water use in the study area should result in further changes in the agriculture economic sector, as well as those economic sectors that are supported by M&I water.

This analysis evaluated the effects of changes in lake and reservoir storage, changes in flows, changes in hydropower revenue, and changes in water use on the study area economy using the following indicators:

1. Employment and income affected by recreation visitation
2. Employment and income affected by changes in water use
3. Hydropower generation and revenues
4. Groundwater pumping costs

B. Summary of Effects

Table 3.83 summarizes the effects of the alternatives on the study area economy.

1. Recreation-Related Employment and Income

Economic model results show that recreation-based employment and income are about the same under the alternatives as under current conditions (differences of less than 1 percent). These differences are not considered significant because they would not significantly affect the overall regional economy.

2. Employment and Income Affected by Changes in Water Use

Two analyses were conducted to show the effects of (1) meeting the M&I water demand in Truckee Meadows in 2033 and (2) transferring agricultural water rights in Truckee Meadows and the Truckee Division of the Newlands Project.

For the first analysis, the economic model calculated the amount of employment and income that could be supported by the increase (approximately 36,000 acre feet) in M&I water supplies from current conditions to meet the future M&I demand of 119,000 acre-feet in 2033 in Truckee Meadows under No Action, LWSA, and TROA. Model results show that same amount of employment and income would be supported by the 119,000 acre-foot demand under No Action, LWSA, and TROA.

Table 3.83.—Summary of effects on economic environment

	Current conditions	No Action	LWSA	TROA
Recreation-based employment and income	Baseline (California) Employment: 16,900 jobs Income: $344 million	About the same employment and income as under current conditions (differences of less than 1 percent).	Same as under No Action.	Same as under No Action.
Employment and income affected by changes in water supply	Baseline (Nevada): Employment 199,700 jobs Income: $4.8 billion	About the same employment and income as under current conditions (differences of less than 1 percent).	Same as under No Action.	Same as under No Action.
Hydropower generation and revenues	Wet hydrologic conditions: 65,548 MWh $1.57 million	Wet hydrologic conditions: less than 1 percent greater than under current conditions.	Wet hydrologic conditions: same as under No Action.	Wet hydrologic conditions: 3.7 percent less than under No Action; 3.6 percent less than under current conditions.
	Median hydrologic conditions: 51,485 MWh $1.23 million	Median hydrologic conditions: less than 1 percent less than under current conditions.	Median hydrologic conditions: less than 1 percent less than under No Action or current conditions.	Median hydrologic conditions: 5.9 percent less than under No Action; 6.1 percent less than under current conditions.
	Dry hydrologic conditions: 18,106 MWh $0.43 million	Dry hydrologic conditions: 2.3 percent less than under current conditions.	Dry hydrologic conditions: 1.3 percent less than under No Action. 4 percent less than under current conditions.	Dry hydrologic conditions: 58 percent greater than under No Action; 55 percent greater than under current conditions.
Total annual groundwater development costs	$1,520,395	$3,348,102 or 120 percent greater than under current conditions	40 percent greater than under No Action; $4,696,483 or 200 percent greater than under current conditions.	35 percent less than under No Action; $2,151,982 or 42 percent greater than under current conditions.

For the second analysis, the economic model calculated the effect of transferring agricultural water rights on employment and income. Model results show slightly (less than 1 percent) less employment and income in the study area under No Action, LWSA, and TROA than under current conditions. The economic model also shows less employment and income under TROA than under No Action, but the overall effect on the regional economy would still be less than 1 percent.

3. Hydropower Generation and Revenues

Analysis of operations model results shows that hydropower generation and gross revenues are about 6 percent less under TROA than under No Action and 5.5 percent less than under current conditions in wet hydrologic conditions; about 9.3 percent less than under No Action and about 17 percent less under than under current conditions in median hydrologic conditions, and about 40 percent greater than under No Action and current conditions in dry hydrologic conditions. Any reduction in gross revenue was considered significant and would require compensation.

4. Groundwater Pumping Costs

Based on information provided by TMWA (TMWA, 2004), groundwater usage to meet future M&I water demand would differ under current conditions, No Action, LWSA and TROA. Groundwater production and recharge has associated capital and operation and maintenance costs. Based on a comparison of the annual groundwater costs for each of the alternatives, the least cost alternative is TROA ($2.15 million), followed by No Action ($3.48 million), and LWSA ($4.70 million), all more costly than current conditions ($1.52 million). Under No Action and LWSA, the higher annual costs are due to greater groundwater pumping. Groundwater pumping not only would be greater under LWSA than under current conditions and TROA, but because of groundwater recharge provisions for this alternative, it has greater future capital investments.

C. Recreation-Related Employment and Income

1. Method of Analysis

To analyze the effects on employment and income associated with recreation visitation, this analysis used two models: the recreation model and the regional (multi-county) input-output (I-O) model (economic model).

The recreation model first calculated recreation visitation associated with Truckee River flows and reservoir storage at Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs in wet, median, and dry hydrologic conditions (10-, 50-, and 90-percent exceedences). River flows and storage were generated from the operations model. Next, the recreation model calculated recreation expenditures in the study area associated with recreation visitation. Then, the economic model estimated the employment associated with the recreation expenditures. Once total employment associated with recreation expenditures was estimated, the economic model calculated the income generated by the estimated employment.

The analysis considered the effects on those portions of El Dorado, Nevada, Placer, and Sierra Counties in California and those portions of Churchill, Lyon, and Washoe Counties in Nevada within the study area.

a. Economic Model

BOR, CDWR, Nevada Division of Water Resources-Water Planning, and the Department of Agricultural Economics at UNR developed the regional I-O model.

I-O models are used to estimate changes in employment and income brought on by changes in "outputs" or final demand. Input-output analysis is based on the interdependence of production and consumption sectors in a regional area. Industries must purchase "inputs" from other industries, as well as primary inputs (e.g., water) to produce outputs that are sold either to other industries or to final consumers. Thus, a set of I-O accounts can be thought of as a "picture" of a study area's economic structure. Flows of industrial inputs can be traced via the I-O accounts to show linkages between the industries composing the regional economy. The accounts are also transformed into a set of simultaneous equations that permit the estimation of economic effects (e.g., changes in employment and income) resulting from changes in resources (e.g., water) and management activities.

For this study, the economic model was used to estimate the economic effects resulting from changes in the resource of water, i.e., Truckee River flows and storage in Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs.

Using data collected from a 1999 recreation survey (see "Recreation Model") the recreation model established a relationship between river flows and lake and reservoir storage (generated from the operations model) and recreation visitation. Changes in storage and river flows resulted in changes in recreation visitation. Changes in recreation visitation resulted in changes in recreation expenditures, which trickled through the regional economy, affecting intermediate industry purchases and final demand. The economic model then calculated the resulting changes in recreation-based employment and income in the study area.

Economic impact analysis is not an exact science. I-O methodology, as well as other methods, serves more as a broad indicator of changes to a regional economy due to changes in output and activities. For this study, the economic model was used as a tool to help identify the differences between the alternatives and current conditions and between the action alternatives and No Action.

b. Recreation Model

A recreation model was developed to provide input to the economic model and to calculate recreation visitation associated with Truckee River flows and Donner Lake and Prosser Creek, Boca, and Stampede Reservoir storage.

To develop recreation visitation data, more than 500 visitors along the Truckee River and at these reservoirs were surveyed during the 1999 recreation season. Day use visitors and campers were asked when they visited and how many visits they would make at different flow and storage levels. Visitors also were asked about their expenditures in the study area. (Recreation preferences concerning Lake Tahoe elevations were not collected because operations under the proposed action would not result in a measurable change in surface acreage. The Lake Tahoe economy [retail trade, eating and drinking, lodging, services, etc.] is accounted for in the economic impact function of the economic model.)

Using the survey data, the recreation model developed a mathematical relationship between river flows (generated from the operations model) and river-related recreation.

The survey also collected recreation visitor expenditure data at Donner Lake and Prosser Creek, Stampede, and Boca Reservoirs. Expenditures related to second homeowners from later research were also included in the data. These recreation expenditures, which are made in the regional economy, include such items as licenses, camping fees, hotels or motels, restaurants, groceries, equipment and supplies, rental charges, and fuel. Expenditure data were used to develop expenditure equations for camping and day use visitation. The expenditure equations were applied to the monthly camping and day use visitation estimates to calculate the monthly expenditure estimates based on lake and reservoir storage. These monthly expenditures were summed to a total annual recreation expenditure, which is defined as a direct impact on the regional economy.

To estimate the indirect and induced economic impacts, the direct impact (total annual recreation expenditure) calculated from the recreation model was linked to the economic model by allocating this annual expenditure into economic sectors, such as wholesale and retail trade, eating, drinking, and lodging. The direct impacts "flow though" these economic sectors, resulting in associated purchases of goods and services, which are defined as indirect impacts. The associated purchases of goods and services in the regional area, in turn, cause additional purchases of goods and services brought on by salaries and profits, which are defined as induced impacts. The total impact is the summation of the direct, indirect, and induced impacts brought on by recreation visitation at the lake and reservoirs included in this analysis.

For more information on the economic and recreation models, see the Economic/Recreation Appendix.

2. Threshold of Significance

Establishing a threshold of significance when conducting a regional economic impact analysis is difficult because effects depend on the size and types of employments and income from which effects can be measured (i.e., baseline). For this study, the baseline employment is 216,665 jobs and baseline income is $4.8 billion. It is reasonable to assume that a difference of 1 percent or less from the baseline employment and income under the alternatives is not significant. Thus, a difference of more than 1 percent from the baseline was considered significant.

3. Model Results

Table 3.84 presents annual recreation visitation and associated annual recreation expenditures at Donner Lake and Prosser Creek, Stampede, Boca Reservoirs, and along the river under current conditions and No Action, LWSA, and TROA in wet, median, and dry hydrologic conditions. These visitation and expenditure estimates are based on results from the operations and recreation models. Annual recreation visitation at the reservoirs and along the river covers the recreation activity during all 12 months of the year. Therefore, recreation visitation shown in this section is greater than that shown for the 7 prime recreation months in “Recreation.” The annual recreation expenditures presented in table 3.84 were used to calculate recreation-related employment and income in the study area under current conditions and the alternative.

Most of the direct recreation expenditures and, thus, most of the economic effects would occur in the Truckee River basin in California. Based on the total employment (16,011 jobs) for the California portion of the basin (table 3.82), the recreation-related economic impacts for all of the alternatives on employment are about 1 percent of the total employment in the upper basin of the study area. The income impacts are less than 1 percent of the total income for that portion of the study area.

4. Evaluation of Effects

a. No Action

Recreation model results show that annual recreation visitation and recreation expenditures are nearly the same under No Action and current conditions in wet, median, and dry hydrologic conditions.

At Donner Lake, estimated recreation visitation and expenditures are about the same in wet and dry hydrologic conditions. Visitation and expenditures are about 5 percent less in median conditions than under current conditions, which is made up by greater visitation and expenditures at other reservoirs and along the river corridor.

Reservoir storage and river flows at most sites (Hydrology Appendix) are slightly lower under No Action than under current conditions during the summer recreation season. However, these differences are so slight that associated recreation visitation and recreation expenditures and, hence, associated employment and income, are essentially the same under No Action as under current conditions. The economic effects on regional employment and income are 1 percent or less and, therefore, are not considered significant.

b. LWSA

Recreation visitation and expenditures are about the same under LWSA as under No Action in wet and dry hydrologic conditions and slightly (1.4 percent) greater in median hydrologic conditions. Overall, they are slightly (0.30-2.7 percent) greater in all three hydrologic conditions than under current conditions.

Table 3.84.—Recreation visitation and expenditures

Location	Current conditions			No Action			LWSA			TROA		
	Wet	Median	Dry	Wet	Median	Dry	Wet	Median	Dry	Wet	Median	Dry
Annual recreation visitation												
Donner Lake	134,151	130,046	104,888	134,168	123,194	104,893	134,168	124,684	104,893	134,089	124,684	104,664
Prosser Creek Reservoir	21,531	19,435	9,220	21,574	19,840	11,233	21,574	20,592	11,327	21,487	20,592	15,321
Stampede Reservoir	73,779	71,335	16,156	73,795	71,015	16,373	73,795	73,504	16,358	73,810	73,256	40,997
Boca Reservoir	31,383	25,769	9,303	31,383	25,608	9,166	31,383	25,766	9,150	31,346	27,097	11,482
River recreation	77,571	114,940	123,123	78,775	126,333	123,265	78,781	126,310	123,184	89,984	127,630	117,989
Total annual visitation	338,415	361,525	262,690	339,695	365,990	264,930	339,701	370,856	264,912	350,716	373,259	290,453
Recreation expenditures												
Donner Lake	$8,040,428	$7,794,388	$6,286,543	$8,041,462	$7,383,714	$6,286,851	$8,041,462	$7,473,036	$6,286,851	$8,036,756	$7,473,036	$6,273,111
Prosser Creek Reservoir	$860,938	$777,126	$368,675	$862,649	$793,345	$449,163	$862,666	$837,801	$452,922	$859,193	$837,810	$612,630
Stampede Reservoir	$4,018,096	$3,884,979	$879,884	$4,018,919	$3,867,550	$891,677	$4,018,920	$4,003,097	$890,876	$4,019,772	$4,004,284	$2,232,719
Boca Reservoir	$1,132,770	$930,140	$335,675	$1,132,770	$924,336	$330,837	$1,132,770	$930,030	$330,286	$1,131,446	$978,071	$414,442
River recreation	$2,450,936	$3,593,242	$3,728,186	$2,482,302	$3,978,383	$3,747,153	$2,482,441	$3,978,347	$3,744,323	$2,886,708	$4,046,068	$3,589,899
Total annual expenditures	$16,503,168	$16,979,875	$11,598,963	$16,538,102	$16,947,328	$11,705,681	$16,538,259	$17,222,311	$11,705,258	$16,933,875	$17,339,269	$13,122,801
Regional economic impacts												
Employment Jobs	194	204	158	195	204	159	195	206	159	200	208	168
Income (millions $)	2.84	2.97	2.24	2.84	2.96	2.26	2.85	3.00	2.26	2.92	3.03	2.41

At Donner Lake, visitation and expenditures are the same in wet and dry hydrologic conditions under LWSA as under No Action and current conditions. In median hydrologic conditions, visitation and expenditure under LWSA are somewhat greater (1.2 percent) than under No Action and about 4 percent less than under current conditions. The effects of less visitation would be the same as under No Action.

Economic impact model results shows that the slightly greater visitation and expenditures at most sites results in only slightly greater (less than 1 percent) or no change in employment and income under LWSA than under No Action or current conditions in wet, median, and dry hydrologic conditions.

c. TROA

Visitation and expenditures in wet and median hydrologic conditions are slightly greater (2-3.6 percent) under TROA than under either No Action or current conditions. In dry hydrologic conditions, visitation and expenditures are 6 to 10 percent greater than under No Action or current conditions.

At Donner Lake, visitation and expenditures under TROA are slightly less (less than 1 percent) in wet and dry hydrologic conditions than under No Action or current conditions; they are slightly better (1.2 percent) in median hydrologic conditions than under No Action and about 4 percent less than under current conditions. Again, the slightly less recreation visitation and expenditures in median hydrologic conditions is made up by increases in other reservoirs and along the river corridor.

Economic model results show 2-3 percent more recreation-related employment and income in wet and median hydrologic conditions under TROA than under current conditions and No Action. In dry hydrologic conditions, results show about 6 percent greater employment and income under TROA than under No Action or current conditions, or about 9 more jobs and $0.16 million. The effect would still be not significant when compared to the baseline regional employment and income or to the California portion of the regional baseline.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

D. Employment and Income Affected by Changes in Water Use

1. Method of Analysis

Two analyses were conducted to show the effects of (1) meeting the M&I water demand in Truckee Meadows in 2033 and (2) transferring agricultural water rights in Truckee Meadows and the Truckee Division of the Newlands Project. (A negligible amount of water rights

rights would be transferred in the Carson Division.) An underlying assumption was that TROA would provide greater flexibility to meet future water demand in Truckee Meadows by allowing more M&I water to be stored in the upper basin reservoirs.

For the first analysis, the economic model calculated the amount of employment and income that could be supported by the increase (approximately 36,000 acre feet) in M&I water supplies from current conditions to meet the M&I demand of 119,000 acre-feet in Truckee Meadows under No Action, LWSA and TROA (i.e., in 2033).

To meet the future 119,000 acre-foot annual water demand, TMWA will need to augment its M&I water supplies. The M&I water supply will consist of numerous water sources, including purchased agricultural water rights. The market price for water rights is expected to increase in the future because of demand for a finite resource, i.e., surface water rights in the Truckee Meadows area, with diminishing availability. The increase in price or costs to obtain these water rights is not included in this analysis because of the difficulty of predicting these future costs. It is recognized that the future increase in the price for water rights is a cost which the water right purchaser and, ultimately, the final water user will incur. It is difficult to predict how these future costs could affect the regional economy at this time. The potential effect on the regional economy will depend on the amount of the cost increases and how these increases will be distributed in the regional economy.

The impact area for this analysis encompasses the Truckee River basin but effects would be concentrated in Truckee Meadows and Fernley.

2. Threshold of Significance

As for the indicator of recreation-related employment and income, it is reasonable to assume that a difference of 1 percent or less from the baseline employment and income under the alternatives is not significant. Thus, a difference of more than 1 percent from the baseline indicators was considered significant.

3. Model Results

Table 3.85 presents the changes in water use under current conditions and the alternatives and the effects on employment and personal income. Results are derived from the operations and economic models.

4. Evaluation of Effects

a. No Action

i. M&I Water Supplies

To meet the projected annual M&I demand of 119,000 acre-feet in Truckee Meadows, TMWA plans to continue to exercise its existing water rights and expand its conservation and water acquisition programs.

Table 3.85.—Employment and income affected by changes in water use

	Current conditions	No Action	LWSA	TROA
M&I water supply (acre-feet)				
M&I water supply (Truckee Meadows) (acre-feet)	83,140	119,000	119,000	119,000
Change in M&I water supply (acre-feet)		+35,860	+35,860	+35,860
Economic indicators supported by M&I water supply changes[1]				
Employment		73,023	73,023	73,023
Personal income (millions $)		$1,331.00	$1,331.00	$1,331.00
Agricultural water rights (acre-feet)				
Truckee Meadows	27,937	14,915	14,915	2,616
Truckee Division (Fernley M&I water)	13,885	0	0	0
Total agricultural water rights	41,822	14,459	14,569	2,616
Change in water rights from current conditions	-	-27,253	-27,253	-39,206
Change in water rights from No Action			0	-11,953
Economic indicators affected by transfer of agricultural water rights (compared to current conditions baseline)[2]				
Employment	199,762 (baseline)	-230	-230	-338
Personal income (millions $)	$4,450.22 (baseline)	-$3.06	-$3.06	-$4.40
Economic indicators affected by transfer of irrigation water rights (compared to No Action)[2]				
Employment	199,762 (baseline)	-230	Same as under No Action	-102
Personal income (millions $)	$4,450.22 (baseline)	-$3.06	Same as under No Action	-$1.39

[1] The employment and income estimates are based on that portion of the regional economy that could be supported by the M&I water supply changes.
[2] Employment and income estimates are shown for the Nevada counties in the study area.

M&I water supplies in Truckee Meadows are expected to increase in the future, from approximately 83,140 acre-feet under current conditions to 119,000 acre-feet under No Action (increase of approximately 36,000 acre-feet). Economic model results show that this increase in M&I water supplies supports approximately 73,000 full- and part-time jobs and an associated $1.3 billion in personal income.

ii. Agricultural Water Rights

Irrigation water supplies are expected decline in the future because of the purchase of agricultural water rights in Truckee Meadows and Truckee Division of the Newlands Project for M&I water use. Sierra Pacific anticipates that developers in Truckee Meadows would continue under No Action the current practice of dedicating water rights for new service commitments. Currently, TMWA has dedicated 57,170 acre-feet of former agricultural water rights for future M&I water use.

The operations model assumes that under No Action, irrigation water demand will be reduced by 13,368 acre-feet through additional purchases of agricultural water rights in the Truckee Meadows area and reduced by 13,885 acre-feet in the Truckee Division through the purchase of irrigation water rights for the city of Fernley and for Truckee River water quality under WQSA. Total agricultural water rights then would be 27,253 acre-feet less under No Action than under current conditions, resulting in about 230 fewer full- and part time jobs and $3 million less in income, or less than a 1 percent difference from baseline employment (199,762 jobs) and income ($4.45 billion) for the Nevada portion of the study area. It is not possible to identify precisely where in the study area employment and income loss will occur, but most of the direct impacts would occur in Truckee Meadows and the Fernley area.

b. LWSA

i. M&I Water Supplies

M&I water supplies in Truckee Meadows would be the same under LWSA as under No Action, and the effects would be the same as under No Action.

ii. Agricultural Water Rights

Purchase and transfer of agricultural water rights in Truckee Meadows and the Truckee Division would be the same under LWSA as under No Action, and the effects would be the same as under No Action.

c. TROA

i. M&I Water Supplies

M&I water supplies in Truckee Meadows would be the same under TROA as under No Action, and the effects would be the same as under No Action.

ii. Agricultural Water Rights

Purchase and transfer of agricultural water rights in the Truckee Division would be the same under TROA as under either No Action or LWSA but additional purchases (about 12,000 acre-feet) would occur in Truckee Meadows under this alternative. Economic model results show 102 fewer jobs and $1.39 million less in personal income under TROA than under No Action, or less than a 1 percent difference from baseline employment (199,762 jobs) and income ($4.45 billion) for the Nevada portion of the study area. Economic model results show 338 fewer jobs and $4.4 million less in personal income under TROA than under current conditions. Again, these are less than 1 differences from the baseline. Any decline in employment most probably would be concentrated in Truckee Meadows.

The benefits resulting from the transfer of agricultural water rights to meet future demands for M&I, water quality, recreation, and fish and wildlife habitat would be greater than the projected reduction in associated employment and income.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

E. Hydropower Generation and Revenues

The four Truckee River hydroelectric plants have a maximum capacity of about 10 megawatts. These plants provide non-firm base load power to the regional power system. In 1991, these plants provided less than 1 percent of the total electrical power generated from all of Sierra Pacific's plants. Low Truckee River flows could potentially affect power generation, but greater usage of combustion-generated power could replace any loss of the small amount of power generated by the hydroelectric plants resulting from low flows.

1. Method of Analysis

For this study, gross hydropower revenues were calculated based on the annual power generated by these hydroelectric plants in wet, median, and dry hydrologic conditions. Annual hydropower generation was generated from the operations model. The methodology used to estimate the impacts on gross hydropower revenue was specified in section 7.A.6(a)(4) of the Draft Agreement. An annual energy value was calculated using the California-Oregon Border (COB) Electricity Price Index (2002 data). A weighted annual average value based on firm daily peak and off peak power demand was estimated to be $23.96 per megawatt (MWh) hour or $0.024 per kilowatt-hour. (It is recognized that TMWA charged a higher rate ($56 MWh) based on the market conditions in 2002, but the COB Price Index was used to be consistent with the methodology defined in the Draft Agreement). The annual energy value was multiplied by the hydropower generation to calculate a gross annual hydropower revenue value.

2. Threshold of Significance

For the gross revenue analysis on hydropower generation, any loss in revenue was considered significant and would require compensation. Reduced hydroelectric generation, if any, resulting from implementation of TROA would be compensated consistent with the provisions of TROA.

3. Model Results

Table 3.86 presents hydropower generation and associated gross revenues in wet, median, and dry hydrologic conditions.

Table 3.86.—Modeled annual hydropower generation and gross power revenue

Hydrologic condition	Current conditions	No Action	LWSA	TROA
Annual hydropower generation (MWH)				
Wet	65,548	65,653	65,644	63,196
Median	51,485	51,338	50,957	48,334
Dry	18,016	17,595	17,360	27,846
Annual gross power revenue (millions $)				
Wet	1.57	1.57	1.57	1.51
Median	1.23	1.23	1.22	1.16
Dry	0.43	0.42	0.42	0.67

4. Evaluation of Effects

a. No Action

Operations model results show that hydropower generation ranges from a high of 65,548 MWh in wet hydrologic conditions to a low of 18,015 MWh in dry hydrologic conditions under current conditions. Under No Action, hydropower generation ranges from a high of 65,548 MWh and low of 17,595 MWh, and associated gross power revenues range from a high of $1.6 million to a low of about $0.4 million. Hydropower generation and revenues are about the same (1 percent difference) under No Action as under current conditions in wet and median hydrologic conditions. In dry hydrologic conditions, gross revenues are $10,076 or about 2 percent less under No Action than under current conditions.

b. LWSA

Hydropower generation ranges from a high of 65,644 MWh in wet hydrologic conditions to a low of 17,360 MWh in dry hydrologic conditions under LWSA. Associated gross power revenues range from a high of $1.6 million to a low of about $0.4 million. Hydropower generation and revenues are the same under LWSA as under No Action and slightly greater (less than 1 percent) than under current conditions in wet hydrologic conditions. In median and dry hydrologic conditions, hydropower generation and revenues are 1 percent less under LWSA than under No Action and 1 to 3 percent less than under current conditions.

c. TROA

Hydropower generation ranges from a high of 63,196 MWh in wet hydrologic conditions to a low of 27,847 MWh in dry hydrologic conditions under TROA. Associated gross power revenues in wet, median, and dry hydrologic conditions are $1.51 million, $1.16 million, and $0.67 million, respectively.

Hydropower gross revenues are about $0.059 million or 3.7 percent less in wet hydrologic conditions, $0.072 million or 5.9 percent less in median hydrologic conditions, and $0.246 million or 58.3 percent more in dry hydrologic conditions under TROA than under No Action.

Hydropower gross revenues are about $0.056 million or 3.6 percent less in wet hydrologic conditions, $0.076 million or 6.12 percent less in median conditions, and $0.236 million or 55 percent more in dry hydrologic conditions under TROA than under current conditions.

Only in dry hydrologic conditions are Sierra Pacific's gross revenues greater under TROA than under No Action or current conditions.

5. Mitigation

Reduced hydroelectric generation, if any, resulting from implementation of TROA would be compensated consistent with the provisions of the Draft Agreement (section 7.A.6).

F. Annual Groundwater Costs

TMWA provided information on the maximum amount of groundwater that could be pumped in the Truckee Meadows in a year due to drought conditions and the associated costs (capital investments and production costs) for each of the alternatives considered in this revised DEIS/EIR. (See Chapter 2, "Alternatives.") The analysis in this section identifies those costs for each alternative and compares them to costs under current conditions and No Action.

1. Method of Analysis

For this study, TMWA provided maximum annual groundwater estimates and the associated annual production cost for each of the alternative. Capital investments (construction of new groundwater pumps) over the study time period were also provided. The annual groundwater production costs are based on the amount of groundwater pumped and the acre-foot pumping cost. For example, if up to 15,950 acre-feet are pumped, then the average pumping rate is about $91 per acre-foot. If 15,951 to 21,930 acre-feet are pumped, then the rate is $200 per acre-foot. From this rate structure, the maximum annual groundwater pumping costs can be estimated based on the amount of groundwater pumped and/or recharged under each alternative. The capital investment costs for new pumping systems were included in this analysis. These investment costs occurred in different times over the study period. To be consistent with the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Standards (Principles and Guidelines), these capital costs were present-valued to beginning of the study period and then calculated on an annual basis to be comparable to the annual groundwater production costs calculated earlier.

2. Threshold of Significance

Comparison of pumping costs among alternatives was used to evaluate significance; costs higher than under No Action were considered significant.

3. Model Results

Table 3.87 shows calculated groundwater pumping costs under current conditions and the alternatives.

Table 3.87.—Groundwater pumping (acre-feet) and development costs ($)

Indicator	Current conditions	No Action	LWSA	TROA
Maximum annual pumping	15,960	21,930	21,930	15,950
Drought year recharge	0	0	4,450	0
Total annual pumping	15,960	21,930	26,380	15,950
Total annual development costs	$1,520,395	$3,348,102	$4,696,483	$2,151,982

4. Evaluation of Effects

a. No Action

Under No Action, TMWA plans to pump an annual maximum amount of 21,930 acre-feet in Truckee Meadows, or 5,970 acre-feet more than under current conditions. The additional pumping costs and capital investments under this alternative would be $1.8 million (120 percent) more in total annual groundwater-related costs than under current conditions.

b. LWSA

Under LWSA, TMWA plans to pump an annual maximum amount of 21,930 acre-feet per year in Truckee Meadows as well as recharge the groundwater by 4,450 acre-feet per year, or 4,450 acre-feet per year more than under No Action and 10,420 acre-feet per year more than under current conditions. The additional pumping costs and capital investments under this alternative would be $1.35 million more in groundwater-related costs than under No Action and $3.2 million more than under current conditions, or about 40 percent more than under No Action and about 200 percent more than under current conditions.

c. TROA

Under TROA, TMWA plans to pump a maximum of 15,950 acre-feet per year in Truckee Meadows, 5,980 acre-feet per year less than under No Action and the same as under current conditions. While the amount of groundwater pumping is the same as under current conditions, future capital investments increase the annual groundwater costs for this alternative, resulting in about $632,000 more (or 42 percent) in groundwater-related costs than under current conditions and $1.2 million less (or 36 percent) than under No Action.

5. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

SOCIAL ENVIRONMENT

I. AFFECTED ENVIRONMENT

This section provides an overview of the current social environment of the study area and describes aspects, including population and demographics, urbanization of Truckee Meadows, and air quality, which were identified by the public as social issues of concern.

A. Overview

For discussion and analytical purposes, the study area has been divided into five distinct components: Lake Tahoe basin, the Truckee River basin in California, Truckee Meadows, agricultural lands in the Newlands Project, and Indian lands.

1. Lake Tahoe Basin

The Lake Tahoe basin attracts residents and visitors because of its numerous recreational opportunities and proximity to the communities around Lake Tahoe and Truckee Meadows. While 85 percent of the Lake Tahoe basin is public land held by the Federal government and managed by USFS, 85 percent of the lakeshore is privately owned. Both California and Nevada maintain State parks in the basin; the largest is Lake Tahoe Nevada State Park on Lake Tahoe's eastern shore.

The 2000 Census estimated about 41,160 housing units in the Lake Tahoe basin. About 32 percent of these were owner-occupied, and 23 percent were renter-occupied; about 40 percent of total available housing—16,660 units—was for seasonal, recreational, or occasional use. Businesses in the Lake Tahoe basin provide goods and services to the tourism and recreation trade, plus the normal mix of community utility and health services, agricultural services, construction and maintenance businesses, and the stores and dealerships associated with any community.

Private lakeshore property owners historically have sought to maintain Lake Tahoe's water elevation and water quality to protect the lakeshore they own and to maintain the aesthetic appeal of the lake. The lake and its scenic surroundings are lures to recreationists and tourists. Other seasonal activities (skiing, camping) and year-round attractions (casinos and other entertainment) provide diversity. Residents and property owners are concerned with maintaining other quality of life factors throughout the basin. Development and use are tightly controlled by the Tahoe Regional Planning Agency. TRPA has broad regulatory authority over private land use and development as well as oversight control in areas such as zoning and water treatment requirements.

2. Truckee River Basin in California

Residents share the aesthetic and environmental concerns of residents closer to Lake Tahoe but generally are less affected by the immediacy of those issues. They also share the “quality of life" values which are characteristic throughout the study area. Many businesses depend on the diversity of tourism and recreational trade attracted to local reservoirs and lakes.

3. Truckee Meadows

Truckee Meadows, which contains the urban Reno-Sparks area, has evolved from a predominantly agricultural area to one of the fastest growing communities in the country. It is about 30 miles northeast of Lake Tahoe in central Washoe County, Nevada.

About 60 percent of the available housing in Truckee Meadows is owner-occupied, and about 40 percent is renter-occupied. Less than 1 percent of the housing is for seasonal, recreational, or occasional use. The area has an average per capita income of slightly more than $24,000. Reno-Sparks depends on the hotel, gaming, and entertainment industries and on the eating, drinking, and lodging businesses that support those enterprises.

Truckee Meadows residents are concerned with maintaining quality of life in the face of growing population and increasing demands on the environment and economy. The continuing transition from an agricultural to nonagricultural lifestyle has created demand for more urban water uses at the expense of rural/farm uses. Likewise, air quality and habitat were not issues 20 years ago but have become important contemporary issues. Consequently, the community has identified the following measures of quality of life: economic vitality, education, health, land use and infrastructure, natural environment, and public health and welfare (Truckee Meadows Tomorrow, 2003).

A heightened awareness of the relationship between environmental concerns and growth is reflected in the 2002 Truckee Meadows Regional Plan (Regional Plan) four planning principles: Regional Form and Development Patterns, Natural Resources Management, public services and facilities, and regional plan implementation. (Truckee Meadows Regional Planning Agency, 2003) These principles guide the goals and policies of the Regional Plan to encourage land use to promote responsible management of the region's air and water resources to attain and maintain Federal and State quality standards. The quality of life indicators and the Regional Plan suggest the community is interested in ensuring a diverse economy with a high standard of living without sacrificing the natural environment.

4. Agricultural Lands on the Newlands Project

This area includes the city of Fernley, city of Fallon, and Naval Air Station Fallon.

When established in 1904, Fernley served travelers on the transcontinental railroad and highway. With the completion of the Truckee Canal in 1905, Fernley evolved into an agricultural center for the farmers served by the Newlands Project. Today, Fernley maintains its rural character but has targeted itself as a location for housing for commuters to Truckee Meadows, small industries, and retirement centers for senior citizens. Town planners believe the lower cost of land and the town's nonurban character appeal to these groups. While subdivided land and housing construction have attracted residents, Fernley's industrial sites are also attracting businesses. The community's residents exist in a delicate balance between enjoying a lower cost of living (compared to Truckee Meadows) and requiring expanded community services.

Agriculture continues to contribute to the economic vitality of Fallon. Farms generate income for owners and laborers. As business enterprises, farms also make contributions in terms of operation and maintenance expenditures, investments in capital equipment, land improvements, and taxes paid on farm sales, purchases, and real estate, much of which is spent in the local economy. While many farmers on the Newlands Project value their way of life, some have chosen to sell their water rights and abandon the practice.

NASF was established as a naval auxiliary station in 1944 following the construction of a military airfield in 1942. It currently is the Navy's major training center for carrier-based aviators. It encompasses approximately 240,792 acres. While Churchill County's early growth and prosperity was founded in agriculture, the county now depends heavily on NASF, which accounted for about 40 percent of Churchill County's jobs (3,077 of 7,150) in 2001.

5. Indian Lands

Indian tribes in the study area include: Pyramid Lake Paiute Tribe: Pyramid Lake Indian Reservation (which includes Pyramid Lake) in Nevada; Reno-Sparks Indian Colony: Reno and Hungry Valley, in Nevada; Fallon Paiute-Shoshone Tribes: Fallon Paiute-Shoshone Reservation and Fallon Colony in Nevada; and Washoe Tribe of Nevada and California: colonies of Carson City, Dresslerville, Stewart, Washoe Ranch (in Nevada) and Woodfords (in California), Pine Nut allotments (in Nevada), and cultural interests at and near Lake Tahoe. See “Indian Trust Resources” for detail.

B. Population

To present a representative picture of the ethnic and racial composition of the study area population, the study area was divided into several areas: Lake Tahoe basin, Truckee River basin in California, Truckee River basin in Nevada, Truckee Meadows, Pyramid Lake, and lower Carson River basin. These areas have been further broken down by county and county subdivision. The number of persons accounted for in the 2000 Census and percentages of population for five racial categories—(1) White, (2) Black or African American, (3) American Indian and Alaska Native, (4) Asian, and (5) Other (includes Native Hawaiian and Other Pacific Islander, Some Other Race, and Two or More Races)—are presented in table 3.88.

The numbers and percentages of the Hispanic or Latino population, a minority ethnic group, are also shown. Those identifying themselves as Hispanic or Latino may be of any race. Percentages were arrived at based on the numbers and totals of the subdivisions for each basin. While the actual population numbers may fluctuate somewhat, depending on seasonal and economic factors (more or fewer jobs related tourism or farm labor, for example), the percentages shown provide a “snapshot” of the population in the study area.

Table 3.88.—Study area population, 2000[1]

	White	Black	Native American	Asian	Other[2]	Total	Hispanic[3]
Lake Tahoe basin							
El Dorado County, California South Lake Tahoe Division/CCD[4]	27,661	232	285	1,558	4,306	34,042	6,847
Placer County, California Lake Tahoe	10,434	54	116	129	1,425	12,158	2,432
Washoe County, Nevada Incline Village	9,053	46	59	156	638	9,952	1,207
Total	47,148	332	460	1,843	6,369	56,152	10,486
Percent of total	84.0	0.6	0.8	3.3	11.3	100.0	18.7
Truckee River basin in California							
Nevada County, California Donner Division/CCD[4]	12,853	35	86	121	1,397	14,492	1,793
Sierra County, California East Sierra Division/CCD[4]	2,350	7	46	3	95	2,501	163
Total	15,203	42	132	124	1,492	16,993	1,956
Percent of total	89.5	0.2	0.8	0.7	8.8	100.0	11.5
Truckee River basin in Nevada							
Lyon County, Nevada Fernley Division/CCD[4]	7,750	39	131	58	618	8,596	759
Storey County, Nevada Clark Division/CCD[4]	803	4	4	22	49	882	52
Washoe County, Nevada Verdi Division/CCD[4]	3,049	15	10	45	74	3,193	113
Total	11,602	58	145	125	741	12,671	924
Percent of total	91.6	0.5	1.1	1.0	5.8	100.0	7.3
Truckee Meadows							
Washoe County, Nevada Flanigan Division[5]	48,426	900	1,232	1,315	4,183	56,056	5,430
New Washoe City Division[6]	10,912	39	79	129	285	11,444	405
Reno-Sparks Division[7]	200,356	6,092	3,540	12,875	33,352	256,215	48,780
Total	259,694	7,031	4,851	14,319	37,820	323,715	54,615
Percent of total	80.2	2.2	1.5	4.4	11.7	100.0	16.9
Pyramid Lake Division/CCD[4]							
Total	395	1	1,221	3	94	1,714	146
Percent of total	23.0	0.1	71.2	0.2	5.5	100.0	8.5
Lower Carson River basin							
Churchill County, Nevada Fallon Division/CCD[4]	20,033	383	1,141	647	1,608	23,812	2,072
Total	20,033	383	1,141	647	1,608	23,812	2,072
Percent of total	84.1	1.6	4.8	2.7	6.8	100.0	8.7
Study area							
Grand total	354,075	7,847	7,950	17,061	48,124	435,057	70,199
Percent of grand total	81.4	1.8	1.8	3.9	11.1	100.0	16.1

[1] Source: 2000 Census of Population.
[2] Other includes remaining population who declared either as being of one race not listed on the chart or as being multi-race.
[3] As explained in the text, the Hispanic population may be of any race.
[4] In the 1990 Census, Division was used. In the 2000 Census, Census county division (CCD) was used. A CCD is a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities used for presenting decennial census statistics.
[5] Washoe County division changes occurred from the 1990 to the 2000 Census. Flanigan County Division is now approximately represented by combining the North Valleys CCD and Warm Springs-Truckee CCD.
[6] Washoe County division changes occurred from the 1990 to the 2000 Census. New Washoe City Division is now approximately represented by the Washoe Valley CCD.
[7] Washoe County division changes occurred from the 1990 to the 2000 Census. Reno-Sparks Division is now approximately represented by combining the Sun Valley CCD, Sparks CCD, Reno North CCD, Reno SouthEast CCD, and Reno SouthWest CCD.

The study area is overwhelmingly (more than 80 percent) white. The largest ethnic segment of the population is Hispanic, about 16 percent. All other groups combined make up less than 10 percent; Native Americans comprise less than 2 percent. More detail regarding population in various parts of the study area follows.

Based on the 2000 Census, with a total population of 56,152 in 2000, the Lake Tahoe basin is about 84 percent white, 3 percent Asian, and less than 1 percent each Black or African American and Native American (American Indian or Alaska Native). The Hispanic ethnic group, which may come from any racial group, is the largest minority, with about 18 percent of the population. The overall population is well educated; more than 85 percent are high school graduates, and more than 20 percent hold bachelor's or advanced degrees.

The Truckee River basin in California has a population of 16,993 with about 90 percent white, and less than 1 percent each Native American, Black, or Asian in 2000. The Hispanic ethnic group accounts for about 12 percent. More than 80 percent are high school graduates, and more than 15 percent have bachelor's or advanced degrees.

The Truckee Meadows population (323,715) is larger than that of all the other regions in the study area combined. It is also more diverse with a distribution of 80 percent white, 2 percent Black, 1.5 percent Native American, and 4 percent Asian. The Hispanic ethnic group accounts for about 17 percent of the population.

The population (11,602) in the Truckee River basin in Nevada (generally north, east, and west of Truckee Meadows) has a racial distribution of 91.6 percent white, about 1 percent each Native American and Asian, and less than 1 percent Black. The largest minority group is Hispanic ethnic, with about 7.3 percent of the population. In general, populations of the smaller agricultural communities along the river tend to be comprised of older residents; a growing community, Fernley is attracting younger people. In the lower Carson River basin, Fallon's population was 7,536 in 2000, and 16,276 people lived in the area immediately around Fallon.

Table 3.89 presents change in population in different parts of the study area between 1990 and 2000; table 3.90 presents population and growth on Indian lands as of 2000; and table 3.91 presents change in rural and urban populations in different parts of the study area between 1990 and 2000.

C. Urbanization of Truckee Meadows

Truckee Meadows is experiencing rapid growth and developing a more urban character, particularly in Reno-Sparks. Consequently, TMWA is expected to acquire additional Truckee Meadows agricultural water rights to total 83,030 acre-feet and transfer these rights to municipal and industrial use. Existing groundwater rights also would be acquired for M&I use.

For example, in Washoe County, as many as 48,500 acres were irrigated in 1960. By 1990, 31,100 acres were irrigated. By 2020, only about 20,869 acres are projected to remain under irrigation. This trend is probably reflective of Truckee Meadows. Similarly, farm-generated income for the entire county reflects the decline of agriculture. While the number of irrigated acres and farm income ratios fluctuate on a year-to-year basis, the trend is the decrease of agriculture and the growth of nonagricultural businesses.

D. Air Quality

The 1970 Clean Air Act and its amendments provide the framework for all pertinent organizations to protect air quality. All states are required to show compliance with the National Ambient Air Quality Standards (NAAQS) or to develop control plans designed to achieve compliance with them. The rules and policies developed under these plans are codified in federally enforceable State Implementation Plans (SIPs) that are submitted to EPA for approval. Under Federal law, States are responsible for controlling stationary pollution sources and for insuring maintenance of motor vehicle pollution control devices.

California law delegates air pollution control authority to local air pollution control districts, primarily based on county boundaries. In the Lake Tahoe basin, the control responsibility for permitting stationary sources is held by El Dorado and Placer Counties.

Nevada has regulatory authority for air quality, except for delegation to its two most populated counties, Washoe (Reno-Sparks metropolitan area) and Clark (Las Vegas). In the Lake Tahoe basin, Nevada permitting authority is split between Washoe County and the State (acting in Carson City and Douglas County).

Under the Federal Clean Air Act, primary air quality planning authority is vested in the States. In California, the California Air Resources Board (CARB) acts as an intermediary between the local air quality agencies and EPA. Along with its authority to set environmental thresholds, TRPA has been granted a role in managing air quality through its transportation and land use management authority. Under this structure, El Dorado and Placer Counties, in consultation with TRPA, jointly develop a plan for the Lake Tahoe Air Basin (LTAB) encompassing the California portion of the Lake Tahoe basin; that plan is then subject to CARB and EPA approval. In Nevada, TRPA cooperates directly with the State and Washoe County in the development of their respective plans.

The baseline air quality standards for the study area are the NAAQS for the federally designated criteria pollutants: particulate matter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb). California has adopted more stringent standards for the same criteria pollutants, as well as additional standards for sulfates, hydrogen sulfide (H_2S), and visibility-reducing particles (VRP). The State standards include special provisions for even lower permissible levels of CO and VRP for the California portion of the LTAB. Nevada also has adopted more stringent standards applicable in the Lake Tahoe basin, matching the California LTAB standards for CO and visibility and cutting the one-hour maximum ozone standard to equal California's statewide standard. Under the federally chartered bi-state compact that created TRPA, the authority to determine environmental thresholds to protect various resources was granted to TRPA. TRPA's thresholds for visibility and CO are essentially the same as the California and Nevada State standards.

Table 3.89.—Study area population and growth rate, 1990-2000[1]

	1990 Population	2000 Population	Annual average growth rate 1990-2000 (percent)
Lake Tahoe basin			
El Dorado County, California South Lake Tahoe Division/CCD[2]	29,652	34,042	1.4
Placer County, California Lake Tahoe Division/CCD[2]	9,257	12,158	2.8
Washoe County, Nevada Incline Village Division/CCD[2]	7,567	9,952	2.8
Total	46,476	56,152	1.9
Truckee River basin in California			
Nevada County, California Donner Division/CCD[2]	9,420	14,492	4.4
Sierra County, California East Sierra Division/CCD[2]	2,029	2,501	2.1
Total	11,449	16,993	4.0
Truckee River basin in Nevada			
Lyon County, Nevada Fernley Division/CCD[2]	5,188	8,596	5.1
Storey County, Nevada Clark Division/CCD[2]	700	882	2.3
Washoe County, Nevada Verdi Division/CCD[2]	2,465	3,193	2.6
Total	8,353	12,671	4.3
Truckee Meadows			
Washoe County, Nevada			
Flanigan Division[3]	790	56,056	5.3
New Washoe City Division[4]	10,109	11,444	1.2
Reno-Sparks Division[5]	231,651	256,215	1.0
Total	242,550	323,715	2.9
Pyramid Lake Division/CCD[2]			
Pyramid Lake Division/CCD[2]	466	1,714	13.9
Lower Carson River basin			
Churchill County, Nevada Fallon Division/CCD[2]	17,760	23,812	3.0
Study area total	327,054	435,057	2.9

[1] Source: 1990 and 2000 Census of Population.

[2] In the 1990 Census, Division was used. In the 2000 Census, Census county division (CCD) was used. A CCD is a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities used for presenting decennial census statistics.

[3] Washoe County division changes occurred from the 1990 to the 2000 Census. Flanigan County Division is now approximately represented by combining the North Valleys CCD and Warm Springs-Truckee CCD.

[4] Washoe County division changes occurred from the 1990 to the 2000 Census. New Washoe City Division is now approximately represented by the Washoe Valley CCD.

[5] Washoe County division changes occurred from the 1990 to the 2000 Census. Reno-Sparks Division is now approximately represented by combining the Sun Valley CCD, Sparks CCD, Reno North CCD, Reno SouthEast CCD, and Reno SouthWest CCD.

Table 3.90.—Population of Indian lands

	1990 Population	2000 Population	Annual average growth rate 1990-2000 (percent)
Reno-Sparks Colony	724	881	2.0
Pyramid Lake Paiute Reservation	1,308	1,734	2.9
Fallon Paiute-Shoshone Reservation and Colony[1]	[2]758	743	-0.2

Source: 1990 and 2000 Census of Population.

[1] Fallon Paiute-Shoshone Reservation and Colony area was changed from the 1990 to the 2000 Census. It is now a combination of Fallon Paiute-Shoshone Colony and the Fallon Paiute-Shoshone Reservation and Off-Reservation Trust Land areas.

[2] Fallon Paiute-Shoshone Tribes, 1990. The 1990 Census showed a population of 546.

Currently, the California portion of the Lake Tahoe area is classified as being in attainment or "unclassified" for all applicable standards except the California standard for PM_{10}, for which it is designated as being in nonattainment. Since 1990, the Nevada portion of the Lake Tahoe area had been identified as being in nonattainment for CO. However, in 2003 the State of Nevada requested EPA to redesignate the Lake Tahoe Nevada area "not classified" CO nonattainment area to attainment for the CO NAAQS and submitted a CO maintenance plan for the area as a revision to the Nevada SIP. EPA approved the maintenance plan and redesignated the Lake Tahoe Nevada nonattainment area to attainment as of February 13, 2004 (68 FR 69611-69618, December 15, 2003).

In Washoe County, the Truckee Meadows hydrographic area is designated as being in nonattainment for CO with a classification of "moderate" since 1990, while the Reno planning area (hydrographic area 212) is designated as being in nonattainment for PM10, with a "serious" classification since 2001. The Fernley area and Truckee Meadows are designated as not meeting primary standards for total suspended particulate (TSP). Since 2001, the Reno area has been designated as being in nonattainment for the one-hour ozone standard (40 CFR 81.329).

EPA has devised a health-based scale of the NAAQS called the Air Quality Index (AQI), formerly called the Pollution Standard Index (PSI). The pollutants are considered unhealthful at a concentration over 100 on the AQI. Since 1990, there has been a general increase in "good" days (AQI of 0-50) and decreases in "moderate" (AQI 51-100) and "unhealthful" (AQI over 101) in Truckee Meadows. The overall decline in violations may be attributed in part to the weather, but it is also due to the use of oxygenated fuels in the winter months, the vapor recovery program for gasoline dispensing facilities, restriction on residential wood burning, Federal emissions limitation on new cars, and vehicle inspection and maintenance requirements (Washoe County, 2003).

Table 3.91.—Study area population urban change, 1990-2000[1]

	1990 % Urban	2000 % Urban	Difference 2000% - 1990%
Lake Tahoe basin			
El Dorado County, California South Lake Tahoe Division/CCD[2]	73	93	20
Placer County, California Lake Tahoe Division/CCD[2]	31	74	43
Washoe County, Nevada Incline Village Division/CCD[2]	95	81	-14
Basin total	68	87	19
Truckee River basin in California			
Nevada County, California Donner Division/CCD[2]	37	51	14
Sierra County, California East Sierra Division/CCD[2]	0	0	0
Basin total	31	43	12
Truckee River basin in Nevada			
Lyon County, Nevada Fernley Division/CCD[2]	100	78	-22
Storey County, Nevada Clark Division/CCD2	0	0	0
Washoe County, Nevada Verdi Division/CCD[2]	36	62	26
Basin total	72	69	-3
Truckee Meadows			
Washoe County, Nevada Flanigan Division[3]	0	86	86
New Washoe City Division[4]	29	31	2
Reno-Sparks Division[5]	92	99	7
Basin total	89	94	5
Pyramid Lake Division			
Pyramid Lake Division/CCD[2]	0	34	34
Lower Carson River basin			
Churchill County, Nevada Fallon Division/CCD[2]	36	64	28
All basins except Reno-Sparks	16	74	58
All basins	80	89	9

[1] Source: 1990 and 2000 Census of Population.
[2] In the 1990 Census, Division was used. In the 2000 Census, Census county division (CCD) was used. A CCD is a subdivision of a county that is a relatively permanent statistical area established cooperatively by the Census Bureau and state and local government authorities used for presenting decennial census statistics.
[3] Washoe County division changes occurred from the 1990 to the 2000 Census. Flanigan County Division is now approximately represented by combining the North Valleys CCD and Warm Springs-Truckee CCD.
[4] Washoe County division changes occurred from the 1990 to the 2000 Census. New Washoe City Division is now approximately represented by the Washoe Valley CCD.
[5] Washoe County division changes occurred from the 1990 to the 2000 Census. Reno-Sparks Division is now approximately represented by combining the Sun Valley CCD, Sparks CCD, Reno North CCD, Reno SouthEast CCD, and Reno SouthWest CCD.

II. ENVIRONMENTAL CONSEQUENCES

A. Introduction

Modifying operations of Truckee River reservoirs could affect the storage and water elevations of lakes and reservoirs and the quantity, quality, timing, and duration of flows, which could indirectly affect the social environment.

This analysis evaluated the effects of changes in reservoir storage and water elevations and flows on the social environment using the following indicators:

1. Population
2. Urbanization of Truckee Meadows
3. Air quality

B. Summary of Effects

Effects on the social environment indicators of population, urbanization of Truckee Meadows, and air quality would be about the same under TROA and LWSA as under No Action.

In the future, under all alternatives, the study area is projected to experience a steadily increasing population, an expansion of M&I water use, and a decline in agricultural-based living. Between 2000 and 2033, the population of Truckee Meadows is projected to increase from 284,147 to 440,874. Under the alternatives, about 13,368 acre-feet of agricultural water rights would be transferred to M&I use in response to increasing population until demand in the Truckee Meadows service area reaches 119,000 acre-feet. Local and State governments would continue to implement regulatory and monitoring programs to maintain compliance with air quality standards. Table 3.92 summarizes these effects.

C. Population

1. Method of Analysis

Future population levels and water demands used in this revised DEIS/EIR are based on projections made by State and regional service and planning entities responsible for planning for M&I water supply and demand in the Lake Tahoe and Truckee River basins.

2. Threshold of Significance

The average annual growth rate for the Washoe County area served by TMWA (1.3 percent) was calculated from projections provided by TMWA (attachment C). Any change from this rate was considered significant.

Table 3.92.—Summary of effects on the social environment

Indicator	Current Conditions	No Action	L WSA	TROA
Population of Truckee Meadows	284,147	440,874	440,874	440,874
Urbanization of Truckee Meadows	M&I water supply of 83,140 acre-feet. Baseline employment: 199,762 jobs Baseline income: $4.5 billion	Change in M&I water supply to meet additional 36,000 acre-foot demand (total demand of 119,000 acre-feet) would support 73,000 full- and part-time jobs and $1.3 billion in personal income. Transfers of agricultural water rights would result in about 234 fewer jobs, and about $3.1 million less in income (differences of less than 1 percent from baseline).	Same as under No Action.	About the same as under No Action (differences in employment and income of less than 1 percent from baseline).
Air Quality	Regulatory programs and monitoring in place to comply with air quality criteria standards.	Same as under current conditions.	Same as under No Action.	Same as under No Action.

3. Evaluation of Effects

a. No Action

In general, the study area is projected to experience a steadily increasing population, M&I expansion, and a decline in agricultural-based living. Simply put, the future under No Action is expected to include more people coming to the study area to live an urban/suburban lifestyle and fewer people continuing to make an agricultural living.

The Washoe County growth rate is consistent with the growth anticipated throughout the region and within the study area. An annual growth rate average of 1.3 percent is estimated for the Washoe County area served by TMWA under the alternatives. This growth rate results in a projected population increase in the study area from 284,147 to 440,874 between 2000 and 2033.

With consistent population growth, the region is expected to face a wide range of predictable growth-related issues and problems. Population increases require an increase in local services, such as schools and hospitals, police and fire fighting capabilities, and community utilities, such as sewage, water supplies, and power. In general, regional and community planning is designed to keep pace with growth.

The projected increase in population also brings with it certain unavoidable conditions and issues associated with the environment. Development of new housing and business communities in the region may affect scenic and recreation values. All of the social benefits and disadvantages that accompany growth and development could change the character of the natural environment. The degree to which environmental change occurs can be controlled by regulation and planning.

b. LWSA

Because population growth is projected to be the same under LWSA as under No Action, effects on population in the study area are the same as under No Action.

c. TROA

Because population growth is projected to be the same under TROA as under No Action, effects on population in the study area are the same as under No Action.

4. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

D. Urbanization of Truckee Meadows

1. Method of Analysis

The effects on urbanization of Truckee Meadows were quantified by evaluating the effect on population associated with changes in water supply, including the transfer of agricultural water rights to M&I use, as discussed in “Economic Environment.” Population is not the only indicator of urbanization of Truckee Meadows, but it provides some perspective on relative differences among the alternatives.

The economic model calculated the amount of employment and income that could be supported by the 36,000 acre-foot increase in M&I water supplies from current conditions to meet the 2033 M&I demand of 119,000 acre-feet. The economic model then calculated employment and income and associated population that could be supported by the increase in M&I supplies. The economic model also calculated the effect of transferring agricultural water rights in Truckee Meadows on regional employment and income and associated population.

2. Threshold of Significance

The same threshold of significance was used as for "Population."

3. Evaluation of Effects

a. No Action

M&I water supplies in Truckee Meadows are expected to increase in the future, from approximately 83,140 acre-feet under current conditions to 119,000 acre-feet under No Action (increase of approximately 36,000 acre-feet). Economic model results show that this increase in M&I water supplies supports approximately 73,000 full- and part-time jobs and $1.3 billion in personal income, associated with a population of about 111,700.

In the past, agricultural lands in Truckee Meadows area have been converted to urban uses, resulting in less water available for agriculture and more water available for M&I use. The operations model assumes under No Action that irrigation water demand will be reduced by 13,368 acre-feet through additional purchases of agricultural water rights in the Truckee Meadows area.

The economic model estimates that the transfer of agricultural water rights in Truckee Meadows under No Action results in about 234 fewer jobs, resulting in about $3.1 million less in income, and about 349 fewer persons than the baseline regional economy. These differences are less than 1 percent and are considered negligible.

In the future, existing groundwater rights also would be acquired to increase use of groundwater supplies for M&I use.

b. LWSA

The same amount of water would be allocated for M&I use under LWSA as under No Action. Changes in employment, income, and population due to transfers of agricultural water rights would be the same as under No Action.

c. TROA

The same amount of water would be allocated for M&I use under TROA as under No Action. However, additional purchases (about 12,000 acre-feet) of agricultural water rights in Truckee Meadows would occur under TROA. Economic model results show 102 fewer jobs, $1.39 million less in personal income, and 152 fewer people under TROA than under No Action, and 338 fewer jobs, $4.4 million less in personal income, and 504 fewer people than under current conditions. These differences are less than 1 percent of the baseline regional economy and are considered negligible.

4. Mitigation

No mitigation would be required because no significant effects would occur under any of the alternatives.

E. Air Quality

1. Method of Analysis

This analysis used information from EPA, the Air Quality Management Division of the Washoe County District Health Department, and the Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality Planning.

2. Threshold of Significance

For this indicator, any violation of air quality standards was considered significant.

3. Evaluation of Effects

a. No Action

Air quality in the Truckee Meadows area may be affected by increased automobile and manufacturing emissions. However, continuing reservoir operations in their existing pattern would not contribute to air quality problems.

Although the population is projected to increase and pollutant sources will also increase, it is expected that existing Federal, State, and/or local programs to safeguard air quality will be enhanced to cope with these changes. Monitoring programs are expected to continue, as well as the existing public education programs and rigorous enforcement of regulations. Other options and programs will be considered to deal with changing conditions when and if they become necessary. Over the period of analysis, it is difficult to assess what measures and quality levels might be in effect or attained. However, continued concern and high values placed on healthy air quality (as evidenced by present programs) indicate that this area's air quality will remain a respected and cared for resource. Continued action by Federal, State, and, especially, local county managers and planners is anticipated.

Reservoir operations, as proposed under No Action, would not affect air quality when compared to current conditions.

b. LWSA

No identifiable population impacts, changes in transportation patterns, or identifiable point source pollution impacts would be caused by LWSA; thus, LWSA would not contribute to any changes in air quality. Effects on air quality in Truckee Meadows would be the same as under No Action.

c. TROA

No identifiable population impacts, changes in transportation patterns or identifiable point source pollution impacts would be caused TROA; thus, TROA would not contribute to any changes in air quality. Effects on air quality in Truckee Meadows would be the same as under No Action.

4. Mitigation

No mitigation would be required because no significant effects would occur under any of the alternatives.

CULTURAL RESOURCES

Cultural resources, the remains of past human activity, are finite, nonrenewable, and often fragile. These resources encompass a broad range and can include specific places associated with traditional ceremonies; artifacts, structures, objects, or buildings; and landscapes associated with a period of time, a person, or historic movements. Federal agencies are required to identify and evaluate the significance of cultural resources located within the area of potential effect (APE) of any Federal undertaking.

Federal agencies' responsibility to consider and protect cultural resources is based on a number of Federal laws and regulations. (See Chapter 5, "Consultation and Coordination.") In particular, the National Historic Preservation Act of 1966, as amended (NHPA), and its implementing regulations for section 106, set out the requirements and process to identify and evaluate cultural resources, assess effects to these resources, and mitigate effects to significant resources which occur as a result of the agency's permitted undertaking. Under section 110 of NHPA, the responsibility of the Federal agency that owns or formally manages land includes identifying and managing the cultural resources on that land, even when there is no new undertaking.

The California Environmental Quality Act also requires consideration and protection of historical and archaeological resources listed in, or determined to be eligible for listing in, certain local registries, the California Register of Historic Resources, and the National Register of Historic Places. CEQA provides that a substantial adverse change to a resource listed or eligible for listing in the specified registries is a significant effect on the environment. Recent follow-up research to the previous DEIS/EIR considered all recent California and local registry cultural resource information within and immediately adjacent to the primary study area to assure that the analysis included all resources to which CEQA applies. And, although Nevada has no specific State requirements regarding environmental analysis of cultural resources similar to NEPA or CEQA, the same followup procedures (checking recorded cultural resources listed by the State register, then corroborating this information with the most recent National Register information available) were done for all Nevada counties within the primary and secondary study areas.

I. AFFECTED ENVIRONMENT

This section summarizes known cultural resources in the area of potential effect and the level of survey conducted to date to identify them as a basis for impact analysis. The vast majority of these sites have not been evaluated for eligibility in the National Register of Historic Places (NRHP). Clearly, the list is incomplete for areas in which no or limited identification efforts have taken place.

A. Definition of Study Area

The Cultural Resources Appendix describes the general settlement and use through time of the study area (location map) and concludes with a list of the types of cultural resources sites that could be expected to occur as a result of this use. The geographic area defined for discussion of existing conditions and alternative analysis is more restricted. Cultural resources that fall near or below maximum monthly elevation of lakes and reservoirs or streams may be affected by submergence or by fluctuations in the elevation, particularly by the resulting erosion (or, in some cases, deposition) of soil in the area of the site. A range of human activities that occur near the edge of the water surface may also affect sites. For examples, see discussion in Nesbitt et al. (1991).

Thus, the critical factors in determining the areas to be considered in the evaluation of potential effects on cultural resources are the maximum monthly elevation and the fluctuation of that elevation in a lake or reservoir, and the maximum monthly flow in the river or its tributaries associated with operating system requirements. The affected areas, referred to collectively as the "primary study area" include (1) the land covered by the maximum water surface, plus a band of up to 200 yards around the perimeter (exact width depends on the terrain and use of the water body) of all system lakes and reservoirs: Lake Tahoe, Donner Lake, Prosser Creek Reservoir, Independence Lake, Stampede Reservoir, and Boca Reservoir; (2) a corridor of approximately 200 yards on either side of the Truckee River for its entire length from Lake Tahoe to Pyramid Lake; (3) similar corridors for stretches of drainages between reservoirs or to the Truckee River; and (4) the land up to the 3,900-foot elevation at Pyramid Lake. The primary study area is greater than the area within which impacts are expected.

The "secondary study area" for this revised DEIS/EIR includes a perimeter of approximately 200 yards around Lahontan Reservoir.

B. Data Sources

In preparing this section and the Cultural Resources Appendix, the following types of sources were consulted: a number of technical reports on small (and a few larger scale) archeological surveys and literature searches, reports on or references to testing or excavation of sites in or near the primary area, general and specific historical and ethnographic works, historic maps, BOR project information, USGS data and staff, flood reports, and site locational data obtained from a number of sources.

It is possible that, despite these substantial efforts, data gaps may occur in site information. These gaps, however, are not believed to affect the overall presentation of impacts and recommendations. Also, properties and sites *eligible* for NRHP are not included in the discussions or tables because very few exist within the study areas, and all occur in locations that would not be affected under any alternative.

A Truckee River-focused historic timeline and bibliographies of relevant historical and archeological sources for both study areas are included in the Cultural Resources Appendix.

The amount and level of detail of site information available for portions of the primary area vary greatly. For example, some Truckee River stretches in which development has taken place (Truckee and Reno/Sparks) have been completely surveyed, even more than once, while other portions (from the Little Truckee River to the State line) have had little to no attention. In some cases, site locations were recorded on 15-minute or 30-minute quadrangles (the best available at the time of survey) or with sketch maps, and exact site location is now uncertain. Sites are known to exist in some areas but have not been recorded. In other cases, while thorough surveys have been completed, final reports have not, and specific information is not available.

In addition, State records centers are in the process of converting archeological and historical site data from hand-plotted maps to computerized GIS layered plotting. In the interim, all site locations obtained from all sources have been plotted as exactly as possible on the appropriate 7-1/2-minute USGS quadrangle. The 264 sites around lakes and reservoirs and the 161 sites along various river reaches are listed in the Cultural Resources Appendix in specific table(s) labeled "CRA.2-(facility or reach)." And, the 77 sites (Historic Properties) in the primary and secondary study areas formally listed in the NRHP are presented in tables CRA.3-A (California) and CRA.3-B (Nevada). (Map 3.1 shows the reaches of river used in this analysis.)

The discussion of known cultural resources within the primary study area begins at Lake Tahoe and extends to Pyramid Lake; the cultural resource discussion for the secondary study area includes Lahontan Reservoir. For each lake or reservoir and reach of river or major tributary, there is a summary description of the amount and level of inventory completed (when known) and a summary of the types of sites recorded. Most of the historic properties listed in tables CRA.3-A and CRA.3-B lie within the limits of a few communities along the Truckee River; discussion of these properties is limited.

C. Cultural Resources in the Study Areas

1. Lake Tahoe

The lands surrounding Lake Tahoe are managed by the Lake Tahoe Basin Management Unit of the U.S. Forest Service, California State Parks and Recreation, and by the TRPA, which oversee development of private and public land. BOR holds title to Lake Tahoe Dam. Cultural resource surveys of most of the Federal lands in the primary area have been completed. The amount of survey work completed on State and private land is unclear but substantial.

Prehistoric sites recorded within the primary area include the following: large and small prehistoric base and temporary campsites, 11 with only hunting material (e.g., flakes, projectile points, scrapers), primarily of basalt with occasional obsidian, and 13 with only milling or grinding features.

Sixteen ethnographic sites include ones identified as fishing or resting places, mortars, a cemetery, and a campsite associated historically with a particular family. A variety of historic sites include 18 with foundations and/or structures, some with trash dumps and one with a well; 20 separate trash dumps; eight road and three railroad alignments; a power line; two sawmills; two logging locations; nine dams, ditches, flumes, and other water control structures, either separate or part of other sites; and a cemetery. Three sites are of unknown type, and two are rock alignments of unknown age. Many of the sites, some recorded in the 1950s, are reported to be badly disturbed and in areas of development.

In addition to these formally recorded sites, a knowledgeable avocational archeologist, Charles E. Blanchard, documented a large number of probable or actual prehistoric and historic sites during a September 1988 survey. Blanchard conducted the survey on foot and by canoe during a period of extreme low water, and plotted the locations around the shoreline on USGS quadrangles. No elevations are available, but the majority of sites are assumed to lie between 6229 feet (maximum elevation under the Truckee River Agreement of 1935) and 6223 feet, the natural rim of the lake. As no cultural material has been recorded on the exposed land above elevation 6230 feet that correlates with these locations, the extent of remaining material within the pool is unknown.

The resources include the following: 30 possible and 13 definite bedrock mortars or slicks, plus one with a possible minnow trap; 31 definite and two possible rock alignments, cairns, and jetties (prehistoric and historic); 20 prehistoric lithic scatters, and one described as protohistoric with flaked glass; three definite fishing-related sites (traps), plus one natural formation that may have been used as a trap; 58 log or rock dock remains (including pilings); 14 historic house or building remains, plus a round log sea wall; 12 areas of historic trash, plus one with only historic ceramics; three definite or possible quarries; nine sites with rails or railroad alignments; one rock shelter; one logging related site, and 34 examples of modern construction added to historic log cribbing.

Tahoe Dam and Outlet Works and the Gatekeepers Cabin are listed in NRHP as a part of the historic Newlands Project, America's first Bureau of Reclamation project.

Of the 109 sites listed in the Cultural Resources Appendix (table CRA.2-Lake Tahoe), 19 extend to the beach (at elevation of approximately 6230 feet) or lie on the beach along or near the water's edge. Three sites are described as going into the water. Two others are described as possibly going into the water but are at elevation 6230 feet. One site is described as in the water near the beach (elevation 6225 to 6230 feet).

No sites along the beach (but not in the water) are directly affected by the current maximum elevation of 6229 feet. These may well be affected by wave action. (See "Sedimentation and Erosion.")

The lake's minimum elevation was 6220 feet (November 1993), so most of the sites noted by the foot and canoe survey appear to fall in the area between elevation 6229 and 6223 feet and are clearly subject to the effects of fluctuation. Sites reported in shallow water at that time would normally be submerged all year.

2. Truckee River: Lake Tahoe to Donner Creek

Lands along this reach of the Truckee River lie within the Tahoe National Forest Truckee Ranger District and the Lake Tahoe Basin Management Unit. One site is recorded in the Lake Tahoe Basin Management Unit portion.

Cultural resources surveys along this reach include some early general investigation and more recent compliance work along utility corridors and for timber sales and commercial development, resulting in intense coverage for some portions and limited or no coverage for others. In particular, a number of sites are recorded in the deltas or on terraces overlooking the confluence of tributary streams and the river.

Forty-three sites have been recorded on this reach, including prehistoric sites with only material associated with hunting, sites with milling material, and sites with both hunting and milling cultural material. Four of these prehistoric sites also include a limited amount of historic material. Among the historic materials are trash scatters, a railroad alignment, town sites, a mine and tailing pile, a rock ring hearth, a hobo camp, and a Basque tree carving.

3. Donner Lake

The resources of Donner Memorial State Park, which arcs around the east and southeast end of the lake, have been defined. As part of a statewide management program, the park's cultural resources, previously identified and newly discovered, were documented and organized into one general site with several loci of activity (Nesbitt, 1990). Survey of portions of the remainder of the perimeter of the lake, much of which is private land, has been limited to areas associated with development and recreation management; the extent is not known at this time. Much of the area within the primary area on the north side of the lake has been disturbed by historic and recent infrastructural/industrial development.

Within Donner Memorial State Park, the following resources have been defined: two prehistoric lithic scatters, one large and one small; the locations of the historic Murphy and Donner cabin sites; material possibly associated with the historic 1864-66 and slightly later development; and a possible Chinese habitation site.

Two other prehistoric sites have been recorded on the south and west ends of the lake. The one on the west end, originally recorded in 1953, is an extensive scatter of thousands of basalt flakes and a number of tools; the other is a smaller basalt lithic scatter. Two known sites are affected by fluctuating elevation.

In their November 1988 survey of areas of the Donner Memorial State Park exposed by low lake elevations, archeologists from the California Department of Parks and Recreation (CDPR) examined a large lithic scatter which extends downslope to elevation 5933 feet. The site was said to be affected by fluctuating elevations, particularly at elevation 5936 feet (Woodward, 1991).

Another site is shown extending downslope along the beach to the maximum elevation; it is not known if the site extends below elevation 5936 feet. If it does, that portion is affected by fluctuating elevation.

4. Donner Creek: Donner Lake to Truckee River

Survey of the area downstream from Donner Memorial State Park has been limited to relatively small areas associated with aspects of development such as utility corridors, highways, and housing.

Four prehistoric sites have been recorded with extensive basalt and lithic scatters and midden (trash pile). One undefined site (possible Pioneer Village #1, and not listed) is noted near the confluence of Cold Creek and Donner Creek. Some of the features of cultural resources sites which are within Donner Memorial State Park and lie along Donner Creek are discussed under Donner Lake.

5. Truckee River: Donner Creek to State Line

Although it is not entirely clear from USGS quadrangles, much of the primary study area along this reach of the river appears to be private land. Surveys of this segment are associated with highway rights-of-way and development and include linear alignments and small and medium size blocks; 40 percent of the area has been surveyed.

Most of the 26 recorded sites are located upstream of the confluence of Prosser Creek and the Truckee River. The prehistoric sites of varying sizes which have been recorded include the following: six basalt flake scatters, some with tools; a flake scatter with obsidian and jasper as well as basalt material; and a campsite with house rings, flakes and points, one lithic scatter, and a shallow midden. Three of the prehistoric sites also have historic materials, including an historic ice company facility and associated debris and a hotel and "historic ruin." The other historic site is the location of the Tahoe Ice Company. One recorded protohistoric and historic Washoe Camp is located along the river at Truckee. The material of three remaining plotted sites is unknown.

The site downstream from the confluence of Prosser Creek and the Truckee River is the Boca Brewery, located on the south side of the Truckee, slightly west of the Little Truckee. Speer (1984) estimated that 10 to 25 percent of the archeological deposit from the brewery's 1893 demise remained. Recent surveys have concentrated on areas within Truckee city limits, as well as the Farad Powerhouse site.

Additionally, two historic sites between Boca Dam and the Truckee River include the Boca townsite (both sides of the Little Truckee River) and a Civilian Conservation Corps camp used during the dam's construction.

6. Prosser Creek Reservoir

Based on the Memorandum of Agreement executed in 1970 transferring project lands to USFS under the Federal Water Project Recreation Act, lands other than those managed by BOR and below elevation 5741 feet are the property of and managed by the Forest Service, which has recorded sites in the primary area. Extent of USFS's reservoir perimeter survey to identify cultural resources is not known, but based on copies of USFS maps, it is estimated to be less than 15 percent.

In August 1957, an intensive but unsystematic survey of the proposed Prosser Creek Reservoir area was conducted to locate "sites of archeological importance" (Elsasser, 1957:1). On the forms for the sites recorded, location is referenced to the Truckee 30-minute quadrangle, by quarter-quarter section; all elevations are given as 5800 feet. Elsasser notes that sites were plotted to the nearest 100-foot contour line and that "sites which might be flooded sometimes appear as being above the expected pool elevations of the reservoirs" (Elsasser, 1957:2). Plots for these sites on 15-minute quadrangles by the site repository do not always match the description and location on the site form. Notes on site forms indicate that certain sites will or may be flooded by the dam's construction. Best judgment has been used as to which sites are below or above the maximum elevation. Two of the 16 sites recorded in the Prosser Creek drainage by the 1957 survey were tested before construction. One of these appears to be outside the primary study area.

Twenty-eight sites have been recorded. These sites include prehistoric basalt flake and flake and tool scatters, one historic campsite with prehistoric lithic material, one lithic scatter, and one lithic scatter with ground stone. One site of unknown type has been recorded by non-USFS work.

7. Prosser Creek: Prosser Creek Reservoir to Truckee River

The amount of survey conducted along this stretch of the river is unknown; USFS may have surveyed a portion. One small prehistoric campsite recorded in the general vicinity may be located in the primary study area.

8. Independence Lake

The extent of professional cultural resources survey around the perimeter of privately owned Independence Lake is unknown but appears to be very limited. The reliability of the results of surveys by State Forest technicians is unknown. Four sites have been recorded around the lake. Two sites (for which accurate site information is available) include locations with Basque tree carvings and a basalt flake scatter. The location of the third site, a prehistoric temporary camp, is unknown. Given the slopes of the valley, the presence of numbers of sites, other than perhaps in the valley floor along the creek beneath the lake, seems unlikely.

9. Independence Creek: Independence Lake to Little Truckee River *and* Little Truckee River: Independence Creek to Stampede Reservoir

Downstream from Independence Lake dam, six sites have been recorded near Independence Creek: the remains of a waterwheel and flume, the circa 1915–18 logging camp of the Hobart Estate Company, two basalt flake scatters, as well as the Henness Pass Road and the old Holcomb Dairy. Only one historic site, a berm, has been recorded on the Little Truckee River stretch between Independence Creek and Stampede Reservoir, and it was deemed not eligible for inclusion on the National Register (Wallner, 1996.) No elevation is available for this site.

10. Stampede Reservoir

In 1957, A.B. Elsasser and P.J.F. Schumacher recorded seven sites in the area later inundated by construction of Stampede Reservoir; the intensity and extent of the survey are unknown. Two additional sites, recorded in 1958 and 1966, were intensively investigated in 1967 by Payen and Olsen. CDPR archeologists and historians have recorded two sites (Nesbitt, et al., 1991), and USFS has recorded five sites within the inundation area. One other site, recorded in 1967, may lie within the inundation area.

Lands surrounding Stampede Reservoir, except those managed by BOR, are part of the Tahoe National Forest, which has recorded sites in the primary study area. Based on USFS maps, perhaps 10 percent of the perimeter of the lake has been formally surveyed, plus a small additional area above elevation 6000 feet.

The 26 sites recorded within the primary study area include prehistoric occupation areas; prehistoric basalt flake and flake/tool scatters of differing extent and intensity; prehistoric sites described as lithic scatters; sites with lithic scatters and milling features, sites whose types are unknown, and the Boca and Loyalton Railroad segment. At one of the prehistoric sites originally recorded as a flake scatter, more than 100 projectile points and large quantities of ground stone artifacts were discovered during excavation. The second excavated site was a large circular stone enclosure, which yielded a small number of projectile points and other tools. In addition to the historic Smith Mill, four of the prehistoric sites have historic materials, largely trash scatters.

Eighteen sites are known near or below the maximum elevation of Stampede Reservoir. Two sites were partially excavated in 1967 and may require no further attention.

11. Little Truckee River: Stampede Reservoir to Boca Reservoir

Eleven sites have been recorded on this stretch of the Little Truckee River. Site information and the usually small, discrete areas surveyed recorded on USFS atlas sheets form the basis of the discussion.

Recorded prehistoric sites include six flake and tool scatters and two others with flaked and ground stone. One is a historic weir on the Little Truckee River. Historic sites include one historic settlement with structural features, debris, railroad bed, trash scatters, and a segment of an emigrant trail. All three historic trash scatters occur at prehistoric sites. Two sites are not defined on the site forms. All except a segment of the California route of the Overland Trail are situated above modeled maximum elevations.

12. Boca Reservoir

In 1939, BOR completed construction of Boca Dam and Reservoir. Although no formal systematic survey of the reservoir area was conducted before construction, between 1954 and 1962, eight sites were recorded below the maximum elevation; at least two of these have been re-recorded by USFS. Locational information is limited for all sites other than those recorded by USFS. Review of copies of USFS atlas maps indicates that the perimeter of the reservoir above maximum elevation has been surveyed.

Sixteen sites recorded to date include prehistoric basalt tool and flake scatters, lithic scatters, prehistoric flake and ground stone scatters, one historic trash scatter, a prehistoric site, and one of unknown type. One of the flake and ground stone sites has historic structural remains. The Boca facility is listed on the NRHP as part of the Newlands Project.

13. Trophy/Mayberry/Oxbow/Spice

Portions of this segment of the study area, particularly the western third, have been surveyed one or more times in response to urban/municipal development and proposed Federal flood control studies.

The 35 recorded sites include several prehistoric lithic scatters and isolates, ranging from small to large and including, in one case, historic trash; prehistoric sites with milling features or ground stone, two with possible shelters; prehistoric sites with both lithic debris and ground stone/milling features, one possibly a Washoe site, one with a possible historic logging camp, and one with a pile of lumber; one prehistoric campsite with petroglyphs, stone rings, lithics, and bedrock metates; and two Washoe sites, one of which was a stratified winter village. Historic sites not found with prehistoric material include five historic irrigation ditches that parallel the river or have their diversion from it in this stretch; one historic corral and rock feature; a ranch complex; a stone wall; remains of the Verdi Lumber Company; other historic foundations and trash; Jameson’s Station; an emigrant trail; and an isolated Chinese bowl rim fragment.

Raven (1992) identified other historic sites whose legal descriptions appear to place them in or near the primary study area in this reach, but these are not formally recorded and, thus, not included in the reach-specific table of the Cultural Resources Appendix. These sites include the locations of Hunter’s Bridge and Hotel, Lake’s Bridge and Hotel, the Stone and Gates Hotel and Bridge, and diversions for the Eastman, Abbey, American Irrigating, Countryman, Central Pacific Railroad, and English Company historic irrigation ditches.

14. Lockwood

Twenty-three surveys have been conducted, largely in the western third of this segment of the study area, and primarily along the highway on the north side of the river and in a few small to medium-sized block surveys. An estimated 20 percent of the total area has been surveyed.

Prehistoric sites recorded include eight lithic and ground stone scatters, one dense, six with shell, and one with pictographs; eight lithic scatters, one of which is a quarry and one isolate; and one "prehistoric campsite." Historic sites include the Patrick, Derby (not relocated in 1990), and Clark townsites; Tracy Powerplant; two historic debris scatters, one of which may be a railroad construction camp; and Derby Diversion Dam, a NRHP (Newlands Project) listed property and BOR's first dam.

15. Nixon

Relatively little of this river reach is reported as having been surveyed; in some cases, portions of block or linear surveys fall near the river. The 12 sites recorded in this reach include one prehistoric lithic scatter; an historic trash dump; two diversion structures; a portion of the Truckee Canal; and the foundations of Adoth townsite. Information on the other sites is lacking.

In 1973, BOR asked Dr. Donald R. Tuohy, who completed a survey of the Pyramid Lake Reservation for the Nevada State Museum in cooperation with the Pyramid Tribe in 1965–66, to identify and indicate the value of sites that could potentially be affected by construction of the proposed Marble Bluff Dam and Fishway. Two sites in the primary study area were excavated. Tuohy and Clark (1979) note that one of these was likely to have been under 4 to 12 feet of water in 1862 and 1868 and up to 10 feet in 1890. The other site was probably inundated in 1862, 1871, and 1891.

Resources recorded in this reach, including the excavated sites, are burials found with house pits, prehistoric and protohistoric artifacts, and habitation sites.

16. Pyramid Lake

In 1927, formal cultural resource investigations within the Pyramid Lake Reservation began, with work focused on excavation of a large cave in Marble Bluff. At the Tribe's request, the work was discontinued and no additional work was undertaken on the reservation until 1965, when the Nevada State Museum entered into a contract with the Tribe to conduct further investigations. Dr. Donald Tuohy directed the work which, in addition to exploring and recording the surface archaeology of the reservation, tested or excavated 102 of the 748 sites located. Additional excavation after 1966 was to be focused on particular classes of sites, including large ones near the mouth of the Truckee River which were badly eroded by the river and heavily collected (Tuohy and Clark, 1979). Small-scale surveys in association with development and improvements have also been conducted on the reservation.

Of the 49 sites recorded at or below elevation 3900 feet and listed (table CRA.2-Pyramid Lake in the Cultural Resources Appendix), 24 have no site record on file. The remaining sites include the following, which seem likely to include all of the possible site types that would occur: three lithic scatters and five lithic isolate locations; two sites with flaked and ground stone; three with pictographs; two with rock alignments, one in conjunction with other materials; four locations with single or multiple caves or rock shelters, with a variety of artifactual material; and five sites with several types of artifacts, including possible habitations. Human remains are reported at three locations, including some at sites with other materials.

The 1960s survey sites have been plotted on 15-minute USGS quadrangles; but in many cases, little information about the sites is available at this time. Locations of all known sites recorded at or below elevation 3860 feet are used in the analysis.

Although the lake‘s beach area has been intensively used and sites are reported near or just above elevation 3800 feet, most of the recorded sites are above elevation 3840 or 3860 feet. Many are along the drainages that flow into the lake. USGS records for Pyramid Lake are not complete, but in all records between 1867 and 1917 (13 years, 19 readings), the elevation is above 3860 feet. In 1871, the elevation was 3884 feet. Elevations declined from that point through 1960. Between November 1950 and September 1960, with multiple readings each year, the highest elevation was 3810 feet, with most readings below elevation 3805 feet. The lowest reading recorded through 2000 was on February 6 and March 6, 1967, at elevation 3784 feet.

The levels and fluctuations of prehistoric Lake Lahontan (of which the Pyramid Lake area was a part) are beyond the scope of this study, but clearly major fluctuations occurred during the late Holocene, the period of occupation by prehistoric groups described in the Cultural Resources Appendix. Base camps for fishing, and perhaps for other purposes, may well have been located near receding or advancing shorelines, which would have been inundated by subsequent higher lake elevations.

17. Lahontan Reservoir

Twenty-nine cultural resources were identified around the perimeter of Lahontan Reservoir. Reservoir operations for irrigation purposes can cause elevation to fluctuate dramatically, particularly in very dry years, when the difference between high and low elevation has been 58 feet. Most sites around the reservoir are prehistoric in nature. In addition to the Lahontan townsite, assorted historic trash dumps and foundations also exist.

II. ENVIRONMENTAL CONSEQUENCES

Modifying operations of Truckee River reservoirs could affect the water surface elevation of lakes and reservoirs and the quantity, quality, timing, and duration of river/tributary flows, which could affect cultural resources located within or near these water bodies. This analysis evaluates environmental consequences on cultural resources using the following indicator:

- Submergence or exposure of cultural resources within specific site areas, as measured by changes in elevation.

All elevations in this analysis are rounded to the nearest whole number because cultural resource surveys never record site elevations in fractions of a foot. For example, 5840.51 feet mean sea level is rounded to 5841 feet msl, while 5840.50 feet msl is rounded to 5840 feet msl.

A. Summary of Effects

The resources of the Truckee River and its tributaries have been used by humans for centuries, and one drainage has been the focus of human management since the mid-1850s. This continued use has affected previously developed cultural resources sites. Flooding, and to a lesser extent, intervening drought, also affected these resources. The effects of historic flows on cultural resources equal or exceed any that would occur under the proposed alternatives, in which overflow of the banks is rare.

Effects on cultural resource sites on land around the perimeter of lakes or on banks of watercourses above the maximum elevation are virtually the same under the alternatives as under current operations and are not usually discussed as a part of alternative analysis. Such effects include collection of artifacts, or destruction by driving across, digging holes in, or clearing site areas for campsites.

Because of the lack of specific information regarding location or extent of some sites, it is difficult to determine the exact effect on some resources. The tables and discussions provide a reasonable view of the kinds of effects and numbers of known sites involved. For more detail on which sites might be affected, see the facility- and reach-specific tables in the Cultural Resources Appendix.

As noted previously, the amount of survey completed for each reach or feature varies substantially. The need for additional survey and for evaluation of known and newly discovered sites within the primary area would be determined by the lead agency in consultation with the California and the Nevada State Historic Preservation Offices.

Table 3.93 summarizes the effects of the alternatives on cultural resources at lakes and reservoirs in the study area.

As shown in table 3.93, there is little, if any difference, between the percentages of cultural resources affected under current conditions and the alternatives. One exception is Stampede Reservoir, where one-third fewer cultural resources would be affected under TROA than under current conditions and the other two alternatives. Another exception is Pyramid Lake, where one resource could be affected under TROA (and current conditions) but not under the other two alternatives. However, the effect would depend on its precise location and area in relation to projected elevations, and could require further research. Therefore, 5 percent fewer cultural resources at lakes and reservoirs would be affected under TROA than under current conditions and the other alternatives.

Table 3.93.—Summary of effects on cultural resources at lakes and reservoirs in the study area

Number [and percentage] of affected cultural resources									
Lake/reservoir	Number of recorded resources	Current		No Action		LWSA		TROA	
		Number	%	Number	%	Number	%	Number	%
Tahoe	109	34	[31]	34	[31]	34	[31]	34	[31]
Donner	3	2	[67]	2	[67]	2	[67]	2	[67]
Independence	4	3	[75]	3	[75]	3	[75]	3	[75]
Prosser Creek	28	9	[28]	9	[28]	9	[28]	9	[28]
Stampede	26	18	[69]	18	[69]	18	[69]	6	[23]
Boca	16	6	[38]	6	[38]	6	[38]	6	[38]
Pyramid Lake	49	15	[30]	14	[29]	14	[29]	15	[30]
Lahontan	29	13	[45]	13	[45]	13	[45]	13	[45]
Total	264	100	[38]	99	38]	99	[38]	88	[33]

Table 3.94 summarizes the effects of the alternatives on cultural resources along river and stream reaches in the study area.

Table 3.94 shows no difference among the percentages of cultural resources along the river/major tributaries that would be affected under current conditions and the alternatives. The only exception is the Adoth townsite, (noted with an *asterisk in the Derby Diversion Dam to Pyramid Lake reach), which could be affected under TROA and current conditions. The effect would depend on Adoth's exact location and area in relation to maximum flows under TROA, and could require further research.

Although operations model results show that approximately 3 percent more sites would be affected under TROA (and current conditions) than under No Action or LWSA, (especially the three in Nevada reaches), because of the methodological limitations to the collection and interpretation of these data, much of this is speculation based on the best available data.

B. Threshold of Significance

For this analysis, an effect on a cultural resource was considered significant when the site is subjected to fluctuating elevation, alternately submerging and exposing it.

C. Method of Analysis

This section describes the method of analysis of effects on cultural resources, including the nature of impacts on cultural resources.

Table 3.94.—Summary of effects on cultural resources along river and stream reaches

Reach	Number of recorded resources	Current		No Action		LWSA		TROA	
		Number [and percentage] of affected cultural resources							
		Number	%	Number	%	Number	%	Number	%
California									
Truckee River Lake Tahoe to Donner Creek	43	5	[12]	5	[12]	5	[12]	5	[12]
Donner Creek: Donner Lake to Truckee River	4	0	[0]	0	[0]	0	[0]	0	[0]
Truckee River: Donner/Boca	26	2	[8]	2	[8]	2	[8]	2	[8]
Independence Creek: Independence Lake to Little Truckee River and Little Truckee River: Independence Creek to Stampede Reservoir	7	2	[28]	2	[28]	2	[28]	2	[28]
Little Truckee River: Stampede Reservoir to Boca Reservoir	11	0	[0]	0	[0]	0	[0]	0	[0]
Prosser Creek: Prosser Creek Reservoir to Truckee River	0	0	[0]	0	[0]	0	[0]	0	[0]
Nevada									
Truckee River: State Line to Lockwood	35	4	[11]	0	[0]	0	[0]	4	[11]
Truckee River: Lockwood to Derby Dam	23	4	[17]	0	[0]	0	[0]	4	[17]
Truckee River: Derby Diversion Dam to Pyramid Lake	12	[1]1	[8]	0	[0]	0	[0]	[1]1	[8]
Total	161	18	[11]	9	[6]	9	[6]	18	[11]

[1] Adoth townsite.

1. Nature of Impacts on Cultural Resources

a. Submergence

The proposed action analyzed in this study includes no physical modifications, and, thus, effects on cultural resources are limited to those associated with submergence and exposure. These effects directly relate to elevation (as msl) of lakes and reservoirs in wet, median, and dry hydrologic conditions and stream reaches in wet hydrologic conditions. Flows in wet hydrologic conditions are much more likely to affect those resources than flows in median or dry hydrologic conditions. (Also see “Approach to Analysis.”)

Submergence results in scouring and deposition of sediment. (Also see “Sedimentation and Erosion.”) It affects cultural resources sites primarily by destroying the context in which they occur by:

- Moving entire sites or individual items from their original location.
- Eroding the soil from around the objects, often collapsing items from one time period (strata) into those from another time period, eliminating much of the information the site contained.
- Redepositing materials in foreign settings.
- Destroying items.
- Depositing layers of soil from elsewhere on moved or in-place materials, creating a false context.

Permanent submergence in a setting without strong currents may protect or have little or no effect on cultural resources, although examination of these resources is difficult. Alternate exposure and resubmergence is particularly damaging to perishable materials.

Effects of submergence on sites also vary with the type of site. A bedrock mortar or milling stone on a large boulder would not suffer from flooding in the same way that a surface scatter of small flakes or a fire hearth would.

On the other hand, submergence, especially total, can protect cultural resources from the negative impacts of vandalism, looting, and other illegal, scavenger- or collector-oriented activities. (See following discussion.)

b. Exposure and Other Possible Impacts

The lapping action of waves, especially in large, exposed bodies of water subject to wind-fueled current action (e.g., Lake Tahoe or Pyramid Lake), can affect cultural resources. Sites located at water's edge, due to the erosive impact of water continuously moving back and forth, are especially vulnerable under any hydrologic condition.

Exposure of sites in areas of public use abets another type of impact not related to water management: the collection of cultural items by private citizens for personal gain or use. Not only are exposed sites generally subject to greater destruction by natural forces, they are exposed to increasing levels of destruction by human hands, as in use of "mud flats" for dirt bike or all-terrain vehicle usage.

2. Approach to Analysis

To conduct the analysis of effects on cultural resources, two primary pieces of information were necessary: site location and elevation. The first was collected and plotted as described previously, under "Affected Environment." Obtaining the second set of data was more difficult. Data on reservoir storage and flows obtained from the operations model were used to develop the maximum elevation(s) under current conditions and the three alternatives in wet, median, and dry hydrologic conditions for lakes and reservoirs, and wet hydrologic conditions for rivers and major tributaries.

Flows in wet hydrologic conditions only were used to analyze effects on cultural resources along streams because elevation equivalents in median hydrologic conditions cannot be readily converted to reliable elevation numbers (unlike lakes.) Moreover, flows in median hydrologic conditions have no effect on cultural resources located near the top or on the bottom of rivers and tributaries. Additionally, effects, if any, are rare in dry hydrologic conditions, because unless the river or stream channel has been relocated—or if the resources were carried from another location—it is highly unlikely that there are cultural resources located at the bottom of river or stream channels. (See chapter 3, "General Methodology" and "Water Resources" and the Hydrology Appendix for details of the operations model and the flows used in analysis.)

a. Lakes and Reservoirs

Although differences in elevation in a lake or reservoir *within* a month could affect sites, the lack of daily information did not compromise the analysis. The effects and sites affected would be the same under the clearly defined maximum and minimum elevations within the body of water, although frequent changes in elevation would accelerate effects.

b. Truckee River and Tributaries

To determine the variation within the monthly flow and the difference in elevation, the records of actual daily flows for the month with the highest flow (USGS arithmetic average) during the period of record for a sample of USGS gauges on the Truckee River were reviewed. The results follow in table 3.95 and appear in the Cultural Resources Appendix as table CRA.1.

Table 3.95.—Example of river gauge data (cfs)

Gauge	Month of maximum	Monthly	High daily[1]	Low daily
Truckee	May 1958	2,400 (4.65 feet)[2]	2,920 (5.17 feet)	2,070 (4.32 feet)
Reno	May 1952	5,679 (8.17 feet)	7,630 (9.29 feet)	4,840 (7.7 feet)
Nixon	June 1983	5,398 (8.6 feet)	6,490 (9.2 feet)	3,350 (7.43 feet)

[1] Daily average.
[2] ( ) approximate gauge height of flow.

In these examples, the difference between high daily flow elevation and the maximum monthly flow elevation never differs by more than 1.1 foot, a small amount given the relative accuracy of plotting cultural resources sites.

Effects on cultural resources along streams were analyzed using maximum monthly flows generated from the operations model**.** The maximum monthly flows were then used to develop maximum elevations under current conditions and the alternatives in wet hydrologic conditions**.**

Translating the simulated flow data developed for river reaches into elevation for the Truckee River was not straightforward. The assumptions made and the approach taken follow. USGS gauging stations on the river were matched with points on reaches from the operations model to the extent possible. Elevations for all gauging stations (many recently installed) were plotted to establish the approximate stream elevation at as many points as possible. Approximate slope between stations was determined to decide if it were reasonable to assume an increase in flow of a given number of feet at one point would be approximately the same increase at another point downstream, absent major inflow. Areas of apparently greater slope were addressed separately. Because of the variability in the number of river elevations within reaches, the accuracy of projected elevation is undoubtedly greater in some reaches than others. The least available information is in the Truckee River from Lake Tahoe to Donner Creek, followed by reach from Donner Creek to the Nevada-California State line. In most cases, the height of the simulated maximum flow above zero gauge height at both ends of a reach was very close.

Potential effects on cultural resources were analyzed as follows.

For reservoirs and lakes:

1. Identifying all sites at which elevation(s) are at or below the maximum elevations, with elevation data based on the operations model.

2. Comparing the elevation of the selected cultural resource sites to the maximum and minimum elevations in wet, median, and dry hydrologic conditions for each lake and reservoir under current conditions and the three alternatives: No Action, LWSA, and TROA.

3. Noting which sites would be submerged or exposed during the year under each of the three hydrologic conditions, with attention to length of time of exposure and radical change of level, if notable.

4. Summarizing effects in the three hydrologic conditions under current conditions and the alternatives.

For the Truckee River, Prosser Creek, and Little Truckee River

1. Identifying the maximum seasonal flow in reaches in wet hydrologic conditions generated from the operations model under current conditions and the three alternatives.

2. Converting the maximum monthly flow data to elevations at the specific gauging stations at both ends of the reach.

3. Estimating flow elevation at intermediate points within the reach.

4. Comparing the elevation of sites to estimated flow elevation.

5. Identifying and noting sites possibly or likely submerged under the maximum elevation, including any relevant information about the sites.

See map 3.1 for the reaches of river and tributaries analyzed; to facilitate analysis, some reaches were combined. Also, site and reach-specific tables in the Cultural Resources Appendix are designed to supplement the following analyses.

D. Model Results and Evaluation of Effects

In many cases, submergence and exposure effects resulting from fluctuations in elevations of lakes and reservoirs under LWSA and TROA are the same or similar to those under No Action. Therefore, only differences are described. Additionally, because flows are almost identical under No Action, LWSA, and TROA, the effects under LWSA and TROA in reaches of the Truckee River and its tributaries are the same as under the No Action, in all hydrologic conditions. Again, only differences are described. All elevations indicated are above mean sea level.

Rather than detailing months that effects are most (or least) likely to occur, seasons are used, as follows:

Season	Early	Mid	Late
Winter	December	January	February
Spring	March	April	May
Summer	June	July	August
Fall;	September	October	November

1. Lake Tahoe

a. Current Conditions

Of the sites listed in the Cultural Resources Appendix, 19 extend to the beach (about elevation 6230 feet) or lie on the beach along or near the water‘s edge. Three are described as going into the water, while two are described as possibly going into the water but are at elevation 6230 feet. One site is described as in the water near the beach (elevation 6225 to 6230 feet). The 1988 survey identified cultural resources along the lake‘s edge below the 6229 foot level; site numbers were not assigned to these, nor have the exact extent or elevations been determined or recorded. Because no cultural material has been recorded on the exposed land above elevation 6230 feet that correlates with these locations, the extent of remaining material within the pool is unknown.

Operations model results show that in wet hydrologic conditions under current conditions, those sites between elevation 6228 and 6230 feet are exposed most of the year. Portions of two sites above elevation 6228 feet are subject to wave action (“Erosion and Other Possible Effects”) all year.

In median hydrologic conditions, elevation averages 6228 feet. Sites above elevation 6227 feet are exposed or in the fluctuation zone, and thus subject to exposure part of the year. Those sites above elevation 6228 feet are exposed all year. Two sites are subject to wave action all year in wet hydrologic conditions.

In dry hydrologic conditions, sites between elevation 6222 and 6229 feet are exposed and submerged respectively. Sites above elevation 6223 feet are exposed or partially exposed in early summer, while sites between elevation 6222 and 6223 feet are exposed or partially exposed fall through spring. Two sites are exposed all year.

b. No Action, LWSA, and TROA

Operations model results show a minimum elevation of 6223 feet in dry hydrologic conditions. When sites are reported as being in shallow water, it is not clear where below elevation 6223 feet they lie. Because all of the sites along the beach lie above elevation 6229 feet (the maximum lake elevation), none would be directly affected under any alternative.

Operations model results show that in wet hydrologic conditions, sites between elevation 6228 and 6229 feet would be exposed in early summer. A portion of two sites would be subject to wave lapping action the entire year.

In median hydrologic conditions, sites above elevation 6227 feet would be exposed or in the fluctuation zone during early winter, and sites between elevation 6227 and 6228 feet would be exposed or in the fluctuation zone the rest of the year. Again, portions of two sites would be subject to wave action all year.

In dry hydrologic conditions, sites above elevation 6222 feet would be exposed or partially exposed in early winter, while those above elevation 6222 feet would be exposed or partially exposed in fall and winter. Two sites would be exposed all year. Portions of these sites could be subject to wave lapping action, depending on water levels.

Because the differences between the maximum and minimum elevations are virtually the same in wet, median, and dry hydrologic conditions—less than one foot—exposure and submergence of all sites is expected to be the same under all alternatives.

2. Truckee River: Lake Tahoe to Donner Creek

a. Current Conditions

Operations model results show that five known sites may be submerged or partially submerged by maximum flows in this reach. Lower flows probably do not affect these sites.

b. No Action, LWSA, and TROA

The maximum flow at the USGS gauge immediately downstream from Lake Tahoe, the upper end of the reach, is 114 cfs. Therefore, the maximum monthly late winter flow of 1,494 cfs in wet hydrologic conditions under all alternatives cannot be directly converted to water surface elevation.

Flow from tributaries in this reach undoubtedly would increase the flow elevation at the Truckee gauge, but no data exist in the operations model for these inflows or for the Truckee gauge. Truckee gauge flows were estimated by subtracting Donner Lake releases from Truckee River flow. The maximum monthly flow at the Truckee gauge is 2,075 cfs in early spring, which is 4.3 feet above zero, or elevation 5862 feet. The water surface elevation along the river was estimated to be at approximately the same level above 0. Five known sites within the primary study area could be submerged only by the highest flows under any of the alternatives.

Sites at the confluence of the Truckee River and its smaller tributaries, such as Squaw Valley, could be affected by combined flows of the river and the tributary, but this is not a result of releases into the Truckee River channel under any alternative.

3. Donner Lake

a. Current Conditions

One site could be affected by fluctuations in lake elevation. A large lithic scatter in Donner Memorial State Park that extends downslope to the maximum projected elevation of 5936 feet is subject to fluctuating elevation in wet and median, hydrologic conditions.

Another site recorded at 5860 feet remains completely submerged under current conditions. It is not known as to whether this site extends up from this elevation.

b. No Action

Operations model results show that fluctuating elevations would affect one site in all hydrologic conditions. In wet and median hydrologic conditions, operations model results show that the elevation fluctuates from below the lower portion of the site up to the portion at the maximum elevation, which would expose the entire site in winter to spring and largely cover it the remainder of the time, subjecting the portion near maximum elevation to potential wave damage. In dry hydrologic conditions, the maximum elevation is below the lowest extent of the site, resulting in exposure all year.

c. LWSA and TROA

As at Lake Tahoe, because operations model results show that the difference between the maximum and minimum elevation for Donner Lake is the same in wet, median, and dry hydrologic conditions—less than a half-foot variant—expected site exposure and submergence are approximately the same under LWSA and TROA as under No Action.

4. Donner Creek: Donner Lake to Truckee River

Operations model results show a maximum flow in this reach of 141 cfs (or elevation 5828 feet) in wet hydrologic conditions under current conditions and the three alternatives. Elevations for three of the four sites recorded along the reach downstream from Donner Memorial State Park are given as 5960 feet. Two of these sites have been excavated and thus require no further consideration. The remaining two sites are above the maximum monthly elevation and would not be affected.

5. Truckee River: Donner Creek to State Line

Operations model results show that in wet hydrologic conditions under current conditions and the alternatives, the maximum monthly flow for the Truckee River from Donner Creek to the Little Truckee River confluence is 2079 cfs (elevation 5862 feet) in late spring. Downstream from the confluence, the maximum monthly flow is 2231 cfs (elevation 5862.1 feet) in early summer.

Three cultural resources are at locations that could be inundated by the maximum monthly flow. It is possible that these sites have been or are being affected by this high flow. Other sites plotted near the river appear to be above the maximum monthly flow elevation. This flow would not affect the Boca Brewery site or the Boca townsite under any of the alternatives.

6. Prosser Creek Reservoir

a. Current Conditions

Nine sites appear to lie partially or completely below the maximum elevation of 5741 feet shown by operations model results. Thus, in wet hydrologic conditions, four sites are submerged all year; three sites are submerged spring through summer and exposed the remainder of the year; and two sites are submerged or in the fluctuation zone in late spring. From late spring through summer, the portions of these sites between elevation 5740 and 5741 feet are submerged or in the fluctuation zone, while other sites are exposed. The lower edge of one site is submerged or in the fluctuation zone from late spring through late summer and exposed the remainder of the year.

In median hydrologic conditions in late spring, three sites are possibly submerged or in the fluctuation zone; these sites are exposed the remainder of the year. The lower portions of two sites are likely in the fluctuation zone in late spring but are exposed the remainder of the year. One site is exposed all year, while four others are submerged all year.

In dry hydrologic conditions, all identified sites are exposed all year.

b. No Action and LWSA

Nine recorded sites appear to lie below the maximum elevation of 5741 feet shown by operations model results. Two sites are partially below the maximum elevation. Five are among the sites located by Elsasser and Shumacher in their 1957 survey of the project area.

At elevation 5741 feet, most sites would be submerged all or part of the time during the summer. In median hydrologic conditions, three sites would be exposed all year, except late spring, when areas up to elevation 5713 feet would be submerged or in the fluctuation zone. The lower portion of two other sites would be covered in late spring; these sites would be exposed the remainder of the year. One site would be exposed all year, and four sites would be submerged all year.

In dry hydrologic conditions, (elevation 5671 feet), all nine sites would be exposed in late winter. The 69.9 foot difference in elevation between wet and dry hydrologic conditions is the same under current conditions. However, given the length of time the sites have been subjected to substantial annual fluctuations in the elevations, the sites may no longer have retained integrity.

c. TROA

Operations model results show that, under TROA in wet hydrologic conditions, three sites would be submerged all year. Five other sites would be exposed during six months in the winter. Three of these five would be submerged or affected by wave action from late spring to early fall. In early summer, the lower edge of one site would be subject to wave action or submerged. This site would be exposed the remainder of the year.

In median hydrologic conditions, no sites would be submerged all of the time, and only one would be partially submerged. From late spring to mid-summer, operations model results show that the elevation is at or near three sites. As a result, these sites are likely to be subject to wave action and possibly submerged in late spring and exposed the remainder of the year. The extreme lower portions of some sites could also be affected in the same way. One other site would be exposed all year.

In dry hydrologic conditions, all sites above 5695 feet would be exposed in late winter.

7. Prosser Creek: Prosser Creek Reservoir to Truckee River

Because no firm site locations are recorded for this area, effects under current conditions and the alternatives cannot be analyzed.

8. Independence Lake

Because only one known historic site is possibly located adjacent to the maximum elevation of the lake, discussion of effects under current conditions is limited**.** The identified site is reported by the site repository to be several miles from Independence Lake—and well above projected maximum elevations—thus, no impacts are expected. The other three sites are well below the lake's minimum elevation in dry hydrologic conditions, as shown by operations model results, so they would remain submerged under current conditions and all alternatives.

9. Independence Creek: Independence Lake to Little Truckee River *and* Little Truckee River: Independence Creek to Stampede Reservoir

Efforts to determine the elevation of the maximum monthly flow in Independence Creek (105 cfs in wet hydrologic conditions in early summer under current conditions and the alternatives) were not useful. With only one gauging station located 0.4 mile downstream from the dam and a considerable drop in elevation along the reach, no estimate of elevation of the flows at the location of the four cultural resource sites can reasonably be made. The two Hobart historic sites (water wheel and logging camp) were undoubtedly placed to take advantage of the creek flows, and some features would reasonably be at the edge of or in the water. The purposes and exact relation of the prehistoric sites to Independence Creek are unknown.

On the Little Truckee River between Independence Creek and Stampede Reservoir, because no elevation for the one historic site (a berm, CA-SIE-1322) was given, effects under current conditions and the alternatives cannot be analyzed.

10. Stampede Reservoir

a. Current Conditions

Of the 17 sites known to be near or below the maximum elevation, two were recorded by CDPR archeologist and historians in 1991, (Nesbitt, et al., 1991); five by USFS; two others in 1958 and 1966; and the remainder in 1957. One other site, recorded in 1967, may lie below the maximum elevation. The sites recorded in 1957 and 1958–1966 were plotted on USGS 30-minute quadrangles replotted on 7 1/2-minute quadrangles. For this analysis, these were plotted by legal description to the quarter/quarter section. Two sites were partially excavated in 1967 and, thus, may require no further attention. Most of the sites are described as flake or flake and tool scatters, mostly basalt. Three of these have other material as well. No elevations are given for six sites.

Operations model results show a maximum elevation of 5949 feet in mid-summer. Therefore, in wet hydrologic conditions under current conditions, 13 sites are submerged all year; a portion of one site between elevation 5942 and 5880 feet is submerged all year, while the portion of the site between elevation 5942 and 5948 feet is in the fluctuation zone from spring to late summer. The portion of another site between elevation 5945 and 5948 feet is in the fluctuation zone from spring through late summer and exposed the remainder of the year. Three sites appear to be subject to wave action when the elevation is 5948 feet.

In median hydrologic conditions (maximum elevation 5933 feet), 11 sites are submerged all year. For two sites, a portion is submerged all year, a portion is in the fluctuation zone, and a portion is exposed all year. Another site probably is subject to wave action from early fall to mid-winter and is submerged the rest of the year.

In dry hydrologic conditions (maximum elevation 5824 feet), 11 sites are exposed all year, and no sites are submerged all year. Portions of three sites between elevation 5832 and 5800 feet are exposed in late winter and early spring, in rising and receding water the remainder of the year, and the portions located between elevation 5832 to 5840 feet are exposed or in a area subject to wave action all year. Another site is exposed in late winter and early spring and is in rising and receding water the remainder of the year.

b. No Action and LWSA

Operations model results show a maximum elevation of 5948 feet in mid-summer in wet hydrologic conditions. At that elevation, most sites would be submerged the entire year. A portion of another would be entirely submerged all year; the remainder of the site would be in the fluctuation zone from spring through summer. Portions of one other site would be in the fluctuation zone from spring through summer and exposed the remainder of the year.

In median hydrologic conditions (maximum elevation 5933 feet), one site would be submerged the entire year. A portion of one site would be submerged, a portion would be in the fluctuation zone, and a portion would be exposed all year. A portion of another site would be submerged the entire year. One site would be exposed, except for late spring, while three others would be exposed all year.

In dry hydrologic conditions (maximum elevation 5834 feet), 10 sites would be exposed and one site would be submerged all year. Portions of three sites would be exposed all year, while other portions would be subject to elevation changes 11 months of the year. Portions of two sites would be exposed the entire year, and other portions would be exposed all year, except late spring. One site would be exposed all months except in late spring, and would be subject to wave action in early summer.

c. TROA

Operations model results show a maximum elevation of 5949 feet in wet hydrologic conditions under TROA. Therefore, 13 sites would be submerged all year. For another site, one portion would be submerged all year, and another portion would be in the fluctuation zone from spring through summer. A portion of another site would be in the fluctuation zone from spring through summer and exposed the remainder of the year. Two other sites are likely to be subject to wave action when the elevation is 5948 feet.

In median hydrologic conditions (maximum elevation 5941 feet), 11 sites would be submerged all year. A portion of another site would be submerged all year, while other portions would be in the fluctuation zone. One portion of yet another site would be submerged all year, and another portion would be in the fluctuation zone from mid-winter to mid-summer. A portion of one site would be exposed from fall to early winter. Three other sites would be exposed all year.

In dry hydrologic conditions (maximum elevation 5884 feet), xix sites and almost all of two others would be submerged all year. The upper portions of these two sites would be in the fluctuation zone. Three other sites would be exposed or in the fluctuation zone in late winter to early spring and submerged the remainder of the year. Portions of two other sites would be submerged or in the fluctuation zone all year, with a portion of one exposed all year. Four sites would be exposed all year.

11. Little Truckee River: Stampede Reservoir to Boca Reservoir

Operations model results show a maximum monthly flow of 973 cfs (estimated elevation of 5620 feet) in wet hydrologic conditions under TROA for this reach of the Little Truckee for the gauge located one mile upstream of Boca Reservoir and projected upstream and downstream. All cultural resources recorded in this reach are above this projected elevation. Therefore, no sites on this reach would be affected under current conditions or the three alternatives.

12. Boca Reservoir

a. Current Conditions

No professional survey to identify cultural resources was conducted within the reservoir pool before construction of Boca Dam. Thus, the effects on only five sites identified near or within the maximum elevation located in conjunction with specific USFS actions or general surveys after construction of the dam are discussed. The effects on other sites which almost certainly exist below the maximum elevation cannot be specifically addressed, although they would be similar to the effects on similar sites at other reservoirs.

Operations model results show a maximum elevation of 5605 feet in wet hydrologic conditions under current conditions. At this elevation, five sites are exposed from fall through early spring. For the remaining period (spring through summer), portions of these sites are submerged. One site is submerged all year.

In median hydrologic conditions (maximum elevation 5575 feet) five sites are exposed for 8 months and submerged or partially submerged from mid-spring to mid-summer, when the portions below elevation 5605 feet are submerged. The other site likely is submerged all year.

In dry hydrologic conditions (maximum elevation 5521 feet), five sites are exposed all year, and the other is completely or partially submerged.

b. No Action and LWSA

Operations model results show a maximum elevation of 5605 feet in wet hydrologic conditions. At this elevation, most sites would remain exposed from late spring to early summer. During the remaining period, portions of sites would be submerged or subjected to wave action. One site would be submerged year-round.

In median hydrologic conditions (maximum elevation 5573 feet), five sites would be exposed for 8 months and submerged or partially submerged from mid-spring to mid-summer, when the portions below elevation 5605 feet would submerged. The other site would be submerged all year. In dry hydrologic conditions (maximum elevation 5523 feet), all Boca Reservoir sites, except one, would be exposed in mid-winter.

c. TROA

Operations model results show a maximum elevation of 5605 feet in wet hydrologic conditions under TROA. At this elevation, five sites would be exposed for 6 months. In the other 6 months, portions of all five sites would be submerged or in the fluctuation zone. Another site also would be submerged. In median hydrologic conditions (maximum elevation 5588 feet), two sites would be exposed for 8 months and covered or partially covered from spring to mid-summer, when portions below elevation 5605 feet would be submerged. Another site would be submerged all year. In dry hydrologic conditions (maximum elevation 5531 feet), five sites would be exposed all year, and another would be submerged.

13. Trophy/Mayberry/Oxbow/Spice

a. Current Conditions and TROA

Discussion of resources in this reach of the river is divided into segments based on USGS gauge locations. The elevation for the maximum flow for the upper end of the segment of the reach between the State line and Reno (3,563 cfs in wet hydrologic conditions in mid-spring) is 5160 feet under current conditions. The estimated river elevation at Verdi, where sites begin for the reach, is 4830 to 4840 feet. For the segment of the reach beginning at Reno, the elevation for the maximum flow (3,513 cfs in wet hydrologic conditions in mid-spring) is 4439 feet. At the Vista gauge near Lockwood, the elevation for the maximum flow (3,679 cfs in wet hydrologic conditions in mid-spring) is 4407 feet.

There is a possibility, but no recorded evidence, that four cultural resource sites may be affected by these flows, which are less or functionally equal to maximum flows under the alternatives. These sites include two between Verdi and the Mogul gauging station, and two between the Mogul gauge and the Reno gage, just above streamflow ***[???]***.

b. No Action and LWSA

There are no projected effects to cultural resources under No Action and LWSA in this reach.

14. Lockwood

a. Current Conditions and TROA

Portions of two sites lie along the river between the Vista gauge and just downstream from the Tracy gauge. The lower portion of one site is reported to have been destroyed largely through gravel operations. The remaining portion is above projected maximum flow elevation. The other site has also been greatly damaged. Based on the flow elevation at Tracy, approximately 2.5 miles downstream, these sites could be affected under current conditions and TROA.

Between the Tracy gauge and Derby Diversion Dam, portions of two sites may lie within the flow elevations shown by operations model results for current conditions and TROA. The first is an isolate out of context, and the other is reported to be disturbed. Because of these factors, these sites are likely to be only mildly affected, if at all, under current conditions and TROA.

b. No Action and LWSA

Because operations model results show lower flows under No Action and LWSA than under current conditions and TROA, no effects are likely.

15. Nixon

a. Current Conditions and TROA

Of the 12 listed sites, six stand unrecorded, so it is impossible to know precisely what these sites are and where they are located. Only the Adoth townsite appears to lie just below the estimated high flow elevation of 4185 feet and could be partially inundated under TROA; however, there is no evidence of flooding reported with the site information.

b. No Action and LWSA

Because operations model results show lower flows under No Action and LWSA than under current conditions and TROA, no effects are likely.

16. Pyramid Lake

a. Current Conditions

As discussed under "Affected Environment," a large number of sites were recorded on the Pyramid Lake Reservation in the mid-1960s by Dr. Donald Tuohy, with others added through compliance work over the years. The 1960s survey sites have been plotted on 15-minute quadrangles, but, in many cases, little information about the sites is available.

Fifteen sites or portions of sites are known to lie within the maximum elevation under current conditions. Two of these sites were human internments that have been disinterred, and one was an isolated basket that has been collected and is not considered further here. Basic information is available for four of the remaining sites: two are lithic scatters; one is a multifeatured site whose features extend upslope from 3800 to 3890 feet; and the other is a fishing camp and possible burial site which extends below elevation 3800 feet into the lake. No site record is currently available for this last site, and status of investigations of the features is unknown.

Operations model results show a maximum elevation of 3852 feet in wet hydrologic conditions under current conditions. At this elevation, 11 of the sites or site locations are submerged the entire year. Portions of two large sites are affected differently. For one site, the portion below elevation 3846 feet is submerged all year, while the portion between elevation 3846 and 3848 feet is in the fluctuation zone, and the portion above elevation 3848 feet is exposed all year. For the other site, the portion below 3846 feet is submerged all year; the portion between 3846 and 3848 feet is in the fluctuation zone; and the portion above elevation 3848 feet is exposed all year. One other site is exposed the entire year.

In median hydrologic conditions (maximum elevation 3837 feet), nine sites are submerged, and three sites are exposed all year. One site is submerged in late spring and early summer and exposed the remainder of the year. A portion of another site between elevation 3800 and 3828 feet is submerged all year; the portion between elevation 3828 and 3830 feet is in the fluctuation zone; and the portion above elevation 3830 feet is exposed all year.

In dry hydrologic conditions (maximum elevation 3822 feet), ten sites are exposed and three are submerged all year. For one site, the portion between elevation 3800 and 3806 feet is submerged all year; the portion between elevation 3806 and 3810 feet is in the fluctuation zone; and the portion above elevation 3810 feet is exposed all year.

b. No Action and LWSA

Operations model results show a maximum elevation of 3850 feet in wet hydrologic conditions. At this elevation, 15 sites or portions of sites would be submerged. As discussed under current conditions, two of these sites were human internments that have been disinterred and one was an isolated basket that has been collected and is not considered further here. Basic information is available for five of the remaining sites: two are lithic scatters; one, a multi-feature site whose features extend upslope from elevation 3800 to

3890 feet; one, a U-shaped rock wall; and one, a fishing camp and possible burial site that extends below elevation 3800 feet into the lake. No site record is currently available for this last site, and status of investigations of the features is unknown.

In median hydrologic conditions (maximum elevation 3835 feet), ten sites would be submerged all year, while three others would be exposed all year. At another site, portions would be submerged all year, portions would be in the fluctuation zone, and portions would be exposed all year.

In dry hydrologic conditions (maximum elevation 3820 feet) three sites would be submerged all year. Portions of another site would be subject to fluctuating elevations. All remaining sites would be exposed all year.

c. TROA

In wet hydrologic conditions (maximum elevation 3853 feet) all of the sites that would be submerged under No Action also would be submerged under TROA. Portions of two others would be submerged, exposed, or in the fluctuation zone.

In median hydrologic conditions (maximum elevation 3839 feet) the same sites that would be submerged under No Action would be submerged under TROA, but fluctuation and exposure of the sites would begin at elevation 3839 feet.

In dry hydrologic conditions (maximum elevation 3822 feet) the same sites submerged under No Action would submerged under TROA. Portions of one site still would be subject to fluctuation or exposure but at different elevations than under No Action.

17. Lahontan Reservoir

a. Current Conditions

Although Lahontan Reservoir receives irrigation water from the Truckee River via the Truckee Canal, it is not a part of the primary study area. It is, however, part of the secondary study area. Twenty-nine cultural resources adjacent to the lake’s perimeter (or close to) were identified in recent follow up research.

Operations model results show that under current conditions and the three alternatives**,** the reservoir’s 4163-foot maximum elevation from mid-spring to early summer in wet hydrologic conditions inundates many of the prehistoric sites, most of which were excavated in the mid-1970s. At this elevation, ten sites are inundated, with two or three more partially covered. Although most of these sites were excavated, there is a chance that some materials may remain. It is possible that other sites remain undiscovered.

In median and dry hydrologic conditions (when Lahontan Reservoir’s elevation is at 4147 and 4113 feet, respectively), it is possible that more prehistoric and historic sites may be uncovered. Many of the reservoir's known sites are well above the 4163 foot elevation, however, and would, therefore, be unaffected.

b. No Action, LWSA, and TROA

Operations model results show that in wet hydrologic conditions under all alternatives, the reservoir's maximum monthly elevation from mid-spring to early summer is 4163 feet—the same as under current conditions. Therefore, effects on cultural resources would be the same as under current conditions.

In median hydrologic conditions (maximum elevation 4146 feet) elevation vary less than one-half foot among the three alternatives. Effects on cultural resources would be the same as under current conditions.

In dry hydrologic conditions, (maximum elevation 4106 feet, or 57 feet lower than in wet hydrologic conditions), all sites, except one, would be exposed. Two sites have no elevation records, and it is possible that more sites could be uncovered.

Finally, operations model results show that the elevation of Lahontan Reservoir fluctuates less than two-thirds of a foot in wet or dry hydrologic conditions. Thus, the hundreds of recorded cultural resource sites located downstream from Lahontan Dam in the Carson River valley would not be affected. Because of this, these resources are not considered further here.

III. MITIGATION

No mitigation is expected. Mitigation under any alternative would occur only if cultural resources are present that are eligible for the NRHP and they are being adversely affected by lake/reservoir operations or land uses or are being damaged by natural agents.

BOR's policy is to seek to avoid impacts to cultural resources whenever possible. If an action is planned that could adversely affect an archeological, historical, or traditional cultural property site, then BOR will investigate options to avoid the site. However, if avoidance is not possible, protective or mitigative measures will be developed and considered.

Cultural resources management actions will be planned and implemented consistent with consultation requirements defined in 36 Code of Federal Regulations 800, using methods consistent with the Secretary of the Interior's Standards and Guidelines.''

If mitigation is necessary, the lead agency, working in coordination with other involved agencies, tribal authorities, California and Nevada State Historic Preservation Offices, and the Advisory Council on Historic Preservation, will develop a programmatic agreement that will detail any requirements needed to mitigate and resolve adverse effects to cultural resources that may result from implementation of TROA or any alternatives.

INDIAN TRUST RESOURCES

I. AFFECTED ENVIRONMENT

Indian trust resources are legal interests in property or natural resources held in trust by the United States for Indian Tribes or individuals. The Secretary is the trustee for the United States on behalf of Indian Tribes. All Interior bureaus share the Secretary's duty to act responsibly to protect and maintain Indian trust resources reserved by or granted to Indian Tribes or Indian individuals by treaties, statutes, and Executive orders. These rights are sometimes further interpreted through court decisions and regulations. Examples of trust resources are lands, minerals, hunting and fishing rights, and water rights. Interior carries out its activities in a manner that protects trust resources and avoids adverse impacts when possible. When adverse impacts cannot be avoided, appropriate mitigation or compensation is to be provided in consultation with the affected Tribes and/or individuals.

Indian trust resources were assessed in consultation with the following tribes in the study area: Pyramid Lake Paiute Tribe—Pyramid Lake Indian Reservation (which includes Pyramid Lake) in Nevada; Reno-Sparks Indian Colony—Reno and Hungry Valley, in Nevada; Fallon Paiute-Shoshone Tribes—Fallon Paiute-Shoshone Reservation and Fallon Colony in Nevada; and Washoe Tribe of Nevada and California—colonies of Carson City, Dresslerville, Stewart, Washoe Ranch (in Nevada) and Woodfords (in California), Pine Nut allotments (in Nevada), and cultural interests at and near Lake Tahoe.

Trust resources of these Tribes include land, water rights, and fish and wildlife; incomes are derived from these resources. The Tribes are concerned with regional water quality and quantity, water distribution, fish and wildlife, and wetlands.

A. Pyramid Lake Indian Reservation

The formal recognition of the trust relationship between the Pyramid Tribe and the United States can be based on the 1859 withdrawal for Indian use of "a tract of land in the northern portion of the valley of the Truckee River, including Pyramid Lake." After subsequent surveys, an Executive order was issued in March 1875 that further acknowledged the reservation of the Pyramid Lake Paiutes. The reservation presently covers 475,085 acres.

P.L. 101-618 affirmed that "all existing property rights or interests, all of the trust land within the exterior boundaries of the Pyramid Lake Indian Reservation shall be permanently held by the United States for the sole use and benefit of the Pyramid Tribe (Section 210[b][1])." This legislation also recognizes Anaho Island as a part of the reservation and affirms tribal ownership of the Pyramid Lake lakebed and the beds and banks of the lower Truckee River.

B. Reno-Sparks Indian Colony

The Reno-Sparks Indian Colony was created in 1916, when 20 acres were set aside in Reno for use by members of the Northern Paiute, Washoe, and Western Shoshone people. An additional 8 acres were added later. Recently, the colony acquired 1,920 acres in Hungry Valley north of Reno. The land is used primarily for residential purposes.

C. Fallon Indian Reservation and Colony

The Fallon Paiute-Shoshone Indian Reservation is located in Churchill County in west-central Nevada, approximately 10 mile northeast of Fallon and 65 miles east of Reno and Carson City. The Reservation was created following the General Allotment Act of 1887, when members of the Paiute and Shoshone Tribes were allotted about 31,360 acres in the Lahontan Valley. The lands were located in an area that would become part of the Carson Division of the Newlands Project. In 1906, an agreement was made in which Tribal members would exchange their original 160-acre allotments of nonirrigable lands for 10-acre allotments of irrigable lands with paid up water rights. A 1907 order by Interior reserved 4,640 acres on behalf of Tribal members who had relinquished their original allotments. An additional 840 acres adjoining the north boundary of the reservation were set aside in 1917. Water was first delivered to the allotted lands between 1908 and 1910. Currently, 5,513 of the 8,156 acres of the Reservation are water righted. Approximately 1,800-3,175 acres have been irrigated. The Fallon Indian Colony was established with 40 acres, with an additional 20 acres added in 1958; Colony land is used for residential and commercial purposes.

D. Water Rights

1. Pyramid Tribe

The Federal actions that set aside Pyramid Lake Indian Reservation explicitly reserved Pyramid Lake for the Tribe's benefit. Water rights for the reservation were claimed by Interior in 1913, at the same time Interior was claiming water for the Newlands Project. When the *Orr Ditch* Decree was finally issued in 1944, the Pyramid Tribe was given an appropriation date of 1859, senior to all other appropriators. Under the *Orr Ditch* Decree, the Pyramid Tribe was allocated for irrigation an amount not to exceed 4.71 acre-feet per acre for 3,130 acres of bottomland farm (14,742 acre-feet) (Claim 1) and another 5.59 acre-feet per acre for 2,745 acres of benchlands (15,345 acre-feet) (Claim 2). Other than irrigation, no additional water was allocated for the fish or fish habitat in Pyramid Lake or the lower Truckee River.

Over the years, the Tribe has actively worked to protect Pyramid Lake and increase inflow to the lake. With the elevation of Pyramid Lake falling and flows diminishing, the Tribe, in 1973, sought to reopen the *Orr Ditch* Decree to obtain additional water rights for the lake and its fishery. The Tribe alleged that the Federal Government had breached its trust responsibility when it defended water rights for the Newlands Project and did not diligently defend Tribal water rights for all purposes. Following lengthy litigation, the U.S. Supreme Court ruled in 1983 that the *Orr Ditch* Decree was final and binding.

When Interior implemented operating criteria for the Newlands Project in 1967, the Tribe intervened, claiming that the Secretary was taking his trust responsibilities too lightly. The

Secretary was advised that his trust responsibilities included conserving water for the Tribe. Interim implementation of the Newlands Project's Operating Criteria and Procedures decreased diversions from the Truckee River; the conserved water was allowed to flow into Pyramid Lake. Additionally, Stampede Reservoir and, to a lesser degree, Prosser Creek Reservoir, are operated to supplement unregulated Truckee River flows for the benefit of Pyramid Lake fishes.

2. Fallon Paiute-Shoshone Tribes

The Fallon Tribes entered into a settlement agreement that was ratified by Congress as Title I of P.L. 101-618, or the Fallon Paiute-Shoshone Indian Tribes Water Rights Settlement Act of 1990. Section 103 of P.L. 101-618 limits annual water use on the Reservation to 10,587.5 acre-feet (equivalent to 3,025 acres). It also, however, permits the Tribes to acquire up to 2,415.3 acres of land and up to 8,453.55 acre-feet of water rights. These water rights may be used for irrigation, fish and wildlife, M&I, recreation, or water quality purposes, or for any other beneficial use subject to applicable laws of the State of Nevada. An expanded irrigation system was envisioned by P.L. 95-337 and enacted by Congress in 1978; however, the construction of this system was not pursued and was superseded by a financial settlement as part of P.L. 101-618. BIA entered into an agreement with FWS in 1995 to acquire water rights for Reservation wetlands; under that agreement, 1,613.4 acre-feet of water rights have been acquired. Water rights on and appurtenant to the Reservation are served by Newlands Project facilities pursuant to OCAP.

3. Reno-Sparks Indian Colony

Members of the Reno-Sparks Indian Colony believe they may have rights to about 30 acre-feet of water under the *Orr Ditch* Decree.

E. Fish and Wildlife

1. Pyramid Tribe

The Pyramid Lake fishery remains one of the cultural mainstays of the Pyramid Tribe. To protect the fishery, the Tribe maintains two hatcheries; is working cooperatively with Federal, State, and private agencies to protect spawning areas and improve river access for spawning, as noted below; and seeks more inflow to Pyramid Lake, as noted previously. The Tribal fishery program operates hatcheries at Sutcliffe and Numana. Tribal hatcheries raise both the threatened LCT and endangered cui-ui. LCT hatcheries support a world-class fishery; the cui-ui hatchery is a “fail-safe” operation to maintain the strain in case of catastrophic event.

The Tribe uses a portion of the interest from the principle of the $25-million Pyramid Lake Paiute Fisheries Fund, provided under section 208 of P.L. 101-618, for management of the Pyramid Lake fishery. As part of endangered and threatened species recovery efforts, the Federal Government, in consultation and coordination with the Pyramid Tribe, is developing a plan for rehabilitating lower Truckee River riparian habitat to enhance fish passage and spawning. Improvements have occurred to Marble Bluff Dam facilities. Along with conserving fish, the Pyramid Tribe manages and controls fishing and hunting rights on the reservation.

2. Fallon Paiute-Shoshone Tribes

The Tribe has dedicated Reservation acreage to be used for wetland habitat for wildlife.

F. Trust Income

P.L. 101-618 established the $43-million Fallon Paiute-Shoshone Tribal Settlement Fund, the $25-million Pyramid Lake Paiute Fisheries Fund, and the $40-million Pyramid Lake Paiute Economic Development Fund. Interest on the Fallon Paiute-Shoshone Tribal Settlement Fund may be spent according to the Fallon Tribes' investment and management plan for this fund. The Pyramid Tribe has complete discretion to invest and manage the Pyramid Lake Paiute Economic Development Fund; however, funds are not available to the Tribe until TROA becomes effective.

II. Environmental Consequences

Modifying operations of Truckee River reservoirs could affect Indian trust resources. This section evaluates potential effects on the Indian trust resources of water rights and fish and wildlife. No land resources of any tribe would be directly affected under any of the action alternatives.

A. Pyramid Tribe

Lower Truckee River flow and discharge to Pyramid Lake would increase under the TROA alternative. With increased flow and the capacity to manage such water, TROA would: assist in improving lower river water quality; enhance the elevation of Pyramid Lake; enhance the riparian canopy in and stabilize the lower river; enhance recreational opportunities at Pyramid Lake; enhance spawning opportunities for cui-ui; and enhance river habitat for Pyramid Lake fishes. In addition, the exercise of Lower Truckee River agricultural and M&I water rights, including those of the Pyramid Tribe, would continue to be satisfied under all alternatives. Therefore, TROA would generally have beneficial effects on these trust resources. (Trust resources of the Pyramid Tribe are addressed in greater detail in the Water Resources, Water Quality, Sedimentation, Biological Resources, Recreation, Cultural and Socioeconomics sections.)

B. Reno-Sparks Indian Colony

Implementation of any of the action alternatives would have no effect on the exercise of Truckee River water rights. To the extent that the Colony has such water rights, TROA would have no effect on this trust resource.

C. Fallon Paiute Shoshone Tribes

The Carson Division water supply is minimally affected by any of the action alternatives. The water rights on Fallon Indian Reservation are fully served to a 56 percent supply year, which condition is not exceeded according to computer model results. Therefore, the exercise of water rights of the Tribes and individual Indians on Fallon Indian Reservation are satisfied under all alternatives, and TROA would have no effect on this trust resource. (Lahontan Reservoir storage and releases are addressed in greater detail in the Water Resources section.)

D. Washoe Tribe

TROA would not affect flows of the Carson River and would have no effect on land and water resources in the Lake Tahoe basin. Therefore, TROA would have no effect on these trust resources. (Lake Tahoe resources are addressed in greater detail in the Water Quality and Sedimentation sections.)

E. Mitigation

No mitigation would be required because no significant adverse effects would occur under any of the alternatives.

NEWLANDS PROJECT OPERATIONS

The water supply for the Newlands Project is obtained from the Carson and Truckee Rivers. The Carson River is the primary water source for the Carson Division of the Newlands Project. Because storage capacity of upper Carson River basin facilities is limited, nearly all flow in the Carson River upstream of Lahontan Reservoir is unregulated. Use of Carson River water is governed by the *Alpine* Decree. Some of the water in the Carson River is diverted upstream of Lahontan Reservoir by urban and agricultural users in California and Nevada. Truckee River water is diverted into the Truckee Canal at Derby Diversion Dam for irrigation in the Truckee Division and for delivery to Lahontan Reservoir. Water stored in Lahontan Reservoir is released primarily to satisfy the exercise of water rights in the Carson Division.

Newlands Project OCAP have been promulgated to meet project irrigation requirements consistent with the *Orr Ditch* and *Alpine* Decrees while minimizing use of Truckee River water and maximizing use of Carson River water for project purposes. Those decrees specify annual water duties in the Newlands Project of up to 3.5 and 4.5 acre-feet per acre on bottom and bench lands, respectively. OCAP allows for local control of project operations while fulfilling the Secretary of the Interior's (Secretary) responsibilities under the *Orr Ditch* and *Alpine* Decrees and Federal reclamation law and addressing the Secretary's trust responsibilities to the Pyramid Tribe and Fallon Paiute-Shoshone Tribes and obligations under ESA.

Truckee River water is diverted as necessary to satisfy the exercise of Truckee Division water rights consistent with OCAP. For the Carson Division, forecasting techniques, which include information on Truckee River and Carson River runoff, Carson Division demand, and reservoir evaporation and seepage losses, are used to estimate the quantity of Truckee River water necessary to be diverted to meet monthly Lahontan Reservoir storage targets. Variable end-of-month January through June storage targets have been identified in OCAP for Lahontan Reservoir, with the objective of achieving a specified storage at the end June (e.g., 186,000 acre-feet based on the assumed future annual Carson Division demand of approximately 268,700 acre-feet). From July through December, Truckee River water may be diverted to Lahontan Reservoir only when reservoir storage is, or is forecast to be, less than the respective monthly target. Monthly storage targets (in acre-feet) for July through December (based on the annual 268,700 acre-foot demand) are: July -156,000; August - 96,000; September - 60,000; October - 48,000; November - 70,000; December - 97,000. Generally, diversion of Truckee River water to the Truckee Division will vary directly with demand; diversion to the Carson Division will vary directly with demand but inversely to and depending in large part on Carson River inflow to Lahontan Reservoir (e.g., if storage targets are met or exceeded with Carson River water, diversion of Truckee River water to Lahontan Reservoir is terminated).

Future changes in the disposition and exercise of Truckee Division and Carson Division water rights are assumed to occur independent of TROA. Diversion of Truckee River water to satisfy a portion of the future Newlands Project water demand (described in "Water Resources") will continue to be regulated by OCAP. The potential effects of TROA on the Newlands Project, therefore, would be measured most objectively by comparing the quantity of Truckee River water available for diversion at Derby Diversion Dam, and resulting Truckee Canal inflow to Lahontan Reservoir, Lahontan Reservoir storage, and Lahontan Reservoir releases to the lower Carson River under the various alternatives.

Operations model results for the identified parameters are shown in table 3.96. Values are average annual (in 1,000 acre-feet) for all parameters. The following summary of information on effects of TROA was previously presented in chapter 3.

Table 3.96.—Parameters affecting Newlands Project
(1,000 acre-feet)

	No Action	LWSA	TROA
Diversion to Truckee Canal	51.81	51.67	51.78
Truckee Canal inflow to Lahontan Reservoir	43.84	43.72	43.75
Lahontan Reservoir storage (end of June)	225.28	225.15	224.82
Lahontan Reservoir releases (to Carson Division)	303.40	303.29	303.36

Operations model results show little difference between TROA and the other alternatives, but with slightly less water being provided under TROA. This situation occurs because upstream senior Truckee River water rights are more able to be fully exercised by these water rights holders to create Credit Water under TROA. Effects on Newlands Project water use should be minimal as average annual releases from Lahontan Reservoir are similar (differences of no more than 110 acre-feet) under all alternatives; agriculture and wetlands uses would not be affected to a measurable degree; Indian trust resources on Fallon Indian Reservation would not be affected. Effects on Newlands Project groundwater resources in the study area would result primarily from changes in the amount of Truckee River water diverted to the Truckee Canal to flow to Lahontan Reservoir and would be less than the minor differences between the parameters shown in table 3.97. Changes in flow would affect slightly the amount of seepage to the shallow aquifer adjacent to the canal; the other effect of changes in flow would relate to Lahontan Reservoir releases to the Carson Division. The minor reductions in Truckee Canal flow and Lahontan Reservoir release for irrigation on the Carson Division would have no measurable effect on groundwater resources on the Newlands Project. Diversions to the Truckee Division would not be measurably affected.

The Carson River does not currently cause much sedimentation or erosion in most years because water from the river is routed through 381 miles of canals and laterals. Lahontan Reservoir releases are nearly identical under all alternatives, and TROA would have little effect on the dynamics of sedimentation or erosion at Lahontan Dam, the lower Carson River, or the Carson Division.

The operations model was used to determine the amount of available surface acres at Lahontan Reservoir for water-based recreation during the 7-month recreation season in wet, median, and dry hydrologic conditions (table 3.97), and inferences were made as to how recreationists might respond to changes in surface acreage. As Lahontan Reservoir elevation (and, thus, surface acreage) decreases, mud flats develop and the quality of the fishing experience declines, thus attracting fewer recreationists. Additionally, the relative change in the reservoir surface elevation can be used an indicator of recreation use related to boater access. While reservoir elevation could decline in some years and affect the quality of the recreation experience, the effects among the three alternatives would be similar, and TROA would have no discernable effect on recreation compared to No Action.

Table 3.97.—Average surface acres at Lahontan Reservoir during recreation season

Hydrologic condition	No Action	LWSA	TROA
Wet	12,520	12,529	12,520
Median	6,604	6,600	6,588
Dry	3,673	3,659	3,651

Based on the analysis of recreation at Lahontan Reservoir and on releases to serve Newlands Project water rights, there should be little to no economic impact from TROA compared to No Action.

For biological resources, TROA, compared to No Action, would have little to no effect on fish in Lahontan Reservoir relative to minimum pool maintenance or spawning habitat. TROA would have no effect relative to predator access to bird-nesting islands or on the prey base of bald eagles.

As noted previously, operations model results show that the elevation (or storage) of and releases from Lahontan Reservoir are about the same under all the alternatives. Thus, the recorded cultural resource sites located downstream from Lahontan Dam would not be affected by TROA.

These results suggest that TROA would have no measurable effects on Newlands Project operations, summer recreation at Lahontan Reservoir, or on availability of Truckee Canal flow or Lahontan Reservoir releases for groundwater recharge.

The above results assume a reasonable scenario for management of Newlands Project Credit Water (NPCW) where, as modeled for this revised DEIS/EIR, NPCW establishment was predicated on the forecast ability to release such Credit Water during July without exceeding proposed California Guidelines objectives of 600 cfs downstream from Lake Tahoe, 150 cfs downstream from Prosser Creek Reservoir, 250 cfs downstream from Stampede Reservoir, and 600 cfs in the Truckee River downstream from the confluence with the Little Truckee River. In that scenario, NPCW was stored in Truckee River reservoirs and not released before July 1. This modeled operation resulted in the recreation and release of NPCW in 21 of the 100 years, with a maximum storage of 1,300 acre-feet. This analysis recognizes that release guidelines, while not mandatory, offer targets for achieving instream benefits. In addition to the environmental effects described above, the TROA alternative incorporating this NPCW operation also increased flow and enhanced water quality and enhanced water quality and habitat conditions in the lower Truckee River. Because NPCW in this example would represent a relatively small amount of the total Credit Water dedicated to water quality and Pyramid Lake fishes, only a portion of the identified benefits would be attributed to NPCW.

Other scenarios for the management of NPCW would also be possible and reasonable. To illustrate a reasonable range of conditions and potential benefits, two additional examples are described here. In the first example, a relatively large amount of NPCW (possibly 20-25,000 acre-feet, or more) could be created in some years, primarily during late fall and winter; it would be released to the maximum extent possible in accordance with OCAP prior to August 1 and coordinated with other releases to achieve water quality objectives downstream from Truckee Meadows and limit losses from the Truckee Canal. This example recognizes the variability in precipitation and runoff events and the inherent imprecision in forecasting: it would allow a high runoff event or series of events in the Carson River to fill Lahontan Reservoir sufficiently to achieve (or even exceed) the end-of-June storage target and reduce the likelihood of making diversions from the Truckee River that would exceed the storage target or spill; it would allow NPCW to be released to satisfy the exercise of Carson Division water rights should Carson River inflow to Lahontan Reservoir be insufficient to achieve the end-of-June target storage that year; and NPCW not required to satisfy the exercise of Carson Division water rights that year would convert to Fish Credit Water to the extent not required for higher priority uses. By maximizing the use of the Carson River and minimizing use of the Truckee River in this manner, this example of the management of NPCW would be consistent with the purpose of OCAP. The potential benefits of this example are greater seasonal storage in Truckee River reservoirs, additional Fish Credit Water which could be available for Pyramid Lake fishes, higher Truckee River flows during the summer which would enhance water quality as well as riverine and riparian habitat, and increased inflow to Pyramid Lake. If this operation were implemented, potential effects could be as follows: less storage in Lahontan Reservoir in late spring and early summer which could affect recreational uses; less carryover storage in Lahontan Reservoir; lower flows in the Truckee River during winter and spring; and tributary flows that fluctuate or exceed maximum flow thresholds.

In the second example, NPCW would be stored on a short-term basis, with 2-3,000 acre-feet of water held in upstream reservoirs to help meet the end-of-month Lahontan Reservoir storage targets. Management under this example would benefit Newlands Project operations by reducing fluctuation of diversions at Derby Diversion Dam and maintaining a more constant monthly flow in the Truckee Canal. A more constant flow in the lower Truckee River would also benefit biological resources. In this example, effects would be similar to those identified for the TROA alternative and there would be little effect on Lahontan Reservoir carryover storage.

In any scenario, there should be no effect on delivery of water to the Truckee Division, and all Carson Division diversions would be required to be consistent with Carson Division water rights.

OCAP currently contains a provision for a Credit Water operation involving withholding in Stampede Reservoir potential diversions to the Newlands Project prior to the end of June (in order to avoid exceeding the end-of-June storage target) for release as necessary thereafter through the remainder of the irrigation season; that provision has not been implemented since its approval in 1997 and was not included in the current conditions, No Action, or LWSA operations model assumptions. Exercise of the potential use of NPCW would require amendment to OCAP because OCAP currently contain no provisions for the exercise of NPCW as set forth in the Draft Agreement. No proposal has been formulated at this time to modify OCAP to accommodate NPCW operations.

MINIMUM BY-PASS FLOW REQUIREMENTS FOR SIERRA PACIFIC'S FOUR HYDROELECTRIC DIVERSION DAMS ON THE TRUCKEE RIVER

Minimum bypass flow requirements differ between TROA and current conditions, No Action, and LWSA. The purpose of this section is to review potential impacts of this difference on fish resources (LCT, rainbow trout, and brown trout) of the Truckee River between Lake Tahoe and Truckee Meadows.

I. BACKGROUND

Under No Action and LWSA, Sierra Pacific would agree to continue to maintain, as under current conditions, a minimum bypass flow of 50 cfs at the diversion dams associated with its four hydroelectric plants (Farad, Fleish, Verdi, and Washoe) located along the Truckee River between the Little Truckee River and Truckee Meadows. In addition, as a condition of reconstructing the Farad diversion dam, SWRCB requires Sierra Pacific under current conditions—and would require under No Action and LWSA—to maintain a bypass flow of 150 cfs at the Farad diversion dam, or the total flow of the Truckee River immediately upstream of the dam, whichever is less. Sierra Pacific has *Orr Ditch* Decree rights to divert sufficient water from the Truckee River to provide 327 cfs to 400 cfs at these plants to generate hydroelectric power. Diverted water is conveyed in flumes to hydroelectric plants, where it is either passed through turbines or overflows into spillways before returning to the river.

The diversion dam for Steamboat Ditch (which serves agricultural rights in Truckee Meadows) is located about midway in the 2.4-mile river bypass reach between the Fleish diversion dam and its hydroelectric plant. Because the water entitlement for Fleish hydroelectric plant is the lowest of the four hydroelectric plants—327 cfs—there is generally enough water left in the river to serve Steamboat Ditch, which normally diverts about 42 cfs from the river during the irrigations season.

Implementation of TROA would require a minimum bypass of 50 cfs at each of these hydroelectric diversion dams. The United States and the Pyramid Tribe, under certain conditions and at their discretion, could supplement these minimum bypass flows with the release of Fish Water. Up to 50 cfs (October–April) or up to 150 cfs (May–September) of Fish Water may be released for such supplementation, depending on the rate at which Fish Credit Water, Other Credit Water owned by the United States, and Newlands Project Credit Water is being captured in storage at the time.

Implementation of the TROA minimum bypass provision for the Farad diversion dam depends on a revision of the 150-cfs minimum bypass described under No Action. According to term and condition No. 12 of SWRCB's 401 Certification for the Farad Diversion Dam Replacement Project proposed by Sierra Pacific Power Company, "SPPC shall maintain a minimum flow of 150 cfs in the bypass reach below the diversion dam, or total Truckee River flow immediately upstream of the diversion dam, whichever is less, in the operation area. The SWRCB may, in its discretion, revise this flow requirement to take into account relevant TROA provisions, if information in the final EIS/EIR [for TROA] indicates that a revised flow is more effective than Condition 6-3."

II. DEVELOPMENT OF TROA'S BYPASS PROVISION

Sections 9.E.1 and 9.E.2 of the Draft Agreement were negotiated before the 401 Certification for the Farad Diversion Dam Replacement Project was issued. The objective of these provisions was to develop opportunities to enhance bypass flows at the four diversion dams for the benefit of fish resources in the 8.4 miles of river bypassed by the hydroelectric plant flumes. This was necessary because Sierra Pacific has the right to divert any water from the river, even Fish Water and Fish Credit Water, to meet its diversion needs (up to 450 cfs).

Therefore, the United States and the Pyramid Tribe could release Fish Water specifically to supplement minimum bypass flows, and Sierra Pacific would be compensated by the United States for the related reduction, if any, in hydroelectric generation. Upper limits on supplementation were established to minimize hydroelectric compensation while providing opportunities to achieve minimum fish flows. (See table 3.28).

There would be no limit on the amount of Fish Water that could be released for supplementation when Floriston Rates are being met.[1] However, when Floriston Rates are not being met, the amount of Fish Water that could be released for supplementation would be limited inversely to the rate that Fish Credit Water, Newlands Project Credit Water, and Other Credit Water owned by the United States or Pyramid Tribe were being established at the time. This was intended to reduce the loss of hydroelectric power generation.

III. EXPECTED BENEFITS OF TROA BYPASS PROVISION

TROA would provide fish resource managers a flexible tool to assist in achieving management objectives for seasonal bypass flows at all four hydroelectric diversion dams.

IV. MODEL RESULTS

Hydrologic data simulated by the operations model for current conditions and each alternative were evaluated in this revised DEIS/EIR. Bypass flow data are presented here for TROA and No Action; data for current conditions and LWSA are expected to be identical to No Action and so are not presented here.

For operations under TROA, it was assumed in the operations model that no Fish Water was released specifically to supplement minimum bypass flows, but Fish Water released for other

[1] Not including Fish Water released for bypass supplementation, and Fish Water and Fish Credit Water released to compensate for ice removal from the Highland Ditch.

purposes was used to supplement minimum bypass flows at each diversion dam. Fish Water was bypassed when necessary to achieve a bypass flow of 150 cfs. The amount of Fish Water that could be bypassed was reduced by the rate of simultaneous establishment of Fish Credit Water, Newlands Project Credit Water, and Other Credit Water owned by the United States and the Pyramid Tribe. Also, in accordance with the Draft Agreement, Fish Credit Water was not used for supplementing minimum bypass flows.

Under No Action, water was not released specifically for minimum bypass flows of 150 cfs at Farad or 50 cfs at the other diversion dams.

Because of unregulated flows, the release of Project Waters, and the release of Credit Waters under TROA, flows in the river frequently exceed the diversion rights for the hydroelectric plants. As a consequence, bypass flows are usually greater than minimum requirements. This is indicated in table 3.98, which shows the frequency that simulated average monthly bypass flows achieve or exceed specific flows at the four diversion dams under TROA and No Action for the modeled 100-year period. Flows range from 50 cfs to 300 cfs to encompass minimum bypass flow requirements, and minimum and preferred flows for fish resources. (See table 3.28.)

Table 3.98.—Percent of modeled average monthly bypass flows that achieve or exceed specific flows at Sierra Pacific's hydroelectric diversion dams under No Action and TROA

		Farad	Fleish[1]	Verdi	Washoe
50 cfs	No Action	100	100	100	100
	TROA	100	100	100	100
100 cfs	No Action	64	71	57	49
	TROA	59	75	60	54
150 cfs	No Action	47	66	44	40
	TROA	43	55	43	41
200 cfs	No Action	39	50	39	36
	TROA	38	45	39	37
250 cfs	No Action	36	40	36	34
	TROA	34	39	35	32
300 cfs	No Action	33	37	34	31
	TROA	32	36	32	31

[1] Diversions into Steamboat Ditch were not included.

Minimum bypass flows of 50 cfs are achieved at all dams, but the frequency of higher flows diminish successively under both alternatives. Therefore, as minimum and preferred flows for fish resources increase in magnitude, the frequency of occurrence decreases to the point that preferred flows of 300 cfs or greater occur only about one-third of the time.

The highest bypass percentages under both alternatives always occur at the Fleish diversion dam because of its (relatively) low diversion right. For example, under No Action, even though the minimum bypass requirement at Fleish is 50 cfs, 150 cfs or more is bypassed about 20 percent more often than at Farad where the minimum bypass requirement is 150 cfs. The Fleish data, however, do not include water diverted into Steamboat Ditch. As a consequence, TROA probably provides more water through the entire reach since Fish Water bypassed to supplement minimum bypass flows could not be diverted into Steamboat Ditch.

When segregated by season, minimum fish flows of 200 cfs in the Verdi and Washoe bypass reaches are rarely achieved during late summer, under both alternatives. This is primarily the result of agricultural and hydroelectric plant diversions.

In general, bypass flows achieved under TROA are slightly less than those under No Action. As shown in table 3.99, about 50 percent of the specific flows occur less frequently under TROA than under No Action, likely because of the establishment of Credit Waters and the modeled restrictions on the use of Fish Water to supplement minimum bypass flows.

V. Discussion

Significance of these findings cannot be determined until the importance of the 8.4 miles of bypass reaches to the sustainability of rainbow trout, LCT, and brown trout populations has been determined. It is obvious, however, because of the annual potential to capture large amounts of Fish Water in Stampede Reservoir (125,000 acre-feet) and Prosser Creek Reservoir (30,000 acre-feet) that, if Fish Water were managed specifically to supplement minimum bypass flows to achieve 150 cfs at all hydroelectric diversion dams, the results in table 3.99 would show higher flow percentages for TROA. In fact, it could reasonably be assumed that bypass flows with TROA would be appreciably larger at all diversion dams than under No Action. The converse to this TROA scenario—Fish Water is never used to supplement minimum bypass flows—would likely result in bypass flows being much smaller under TROA than those from the current model run of TROA. Operational model simulations for these two scenarios are planned for the final EIS/EIR.

The benefit of the Draft Agreement bypass provision is that minimum bypass amounts need not be static, but may be varied (managed) according to the needs of the species (management objectives) in the bypass reach. Because use of Fish Water for bypass flows is at the discretion of the United States and the Pyramid Tribe, benefits of this provision can best be realized through cooperative fish resource management among California, Nevada, the United States, and the Pyramid Tribe. Development of integrated or coordinated fish resource management plans and habitat restoration activities would allow for the most diverse, efficient, and beneficial use of Fish Water, Fish Credit Water, and Joint Program Fish Credit Water.

WATER RIGHT CHANGE PETITIONS AND APPLICATIONS

As noted in chapter 1, BOR, WCWCD, and Sierra Pacific have filed change petitions and water appropriation applications with SWRCB to add points of diversion and rediversion, purposes of use, and places of use to the post-1914 appropriative water rights for Prosser Creek, Boca, and Stampede Reservoirs, and Independence Lake, and applications to appropriate water in Stampede and Prosser Creek reservoirs. Approval of the changes petitions and water right applications is needed to effect the numerous transfers and exchanges that are provided for in TROA. The appropriation of water in Stampede and Prosser Creek Reservoirs would allow use of the full capacity of these reservoirs for storing Credit Water. The petitioners have requested that any SWRCB order approving the petitions condition the changes to the water rights on the effectiveness of TROA.

I. EXISTING WATER RIGHT LICENSES AND PERMITS

A. Prosser Creek-Water Right Application No. 18006-License No. 10180-Water Right Holder, BOR

The license is for 30,000 acre-feet of storage from April 10 to August 10 of each year. The license restricts the maximum withdrawal from storage in any one year to 20,162 acre-feet. The point of diversion to storage is at Prosser Creek Dam, in Section 30, T18N, R17E, MDB&M. The purposes of use are: irrigation, domestic, municipal, industrial, fish culture, and recreation. The places of use are: at the reservoir (in California), and in the Truckee Meadows and Newlands Project area in Nevada. As required in the license, the project is operated primarily to allow water that might not otherwise be available from Lake Tahoe to help meet Floriston Rates, to be released from Lake Tahoe in exchange for a like amount of water to be stored in Prosser Creek Reservoir. This is done under TPEA (described in chapter 2). Prosser Creek Reservoir currently stores project water and uncommitted water.

B. Boca Reservoir-Water Right Application No. 5169-License No. 3723-Water Right Holder, Washoe County Water Conservation District

The license is for 40,850 acre-feet of storage from about October 1 of each year to about July 1 of the succeeding year. The point of diversion to storage is at the dam in Section 21,T18N, R17E, MDB&M. There are numerous points of rediversion in Nevada. The purposes of use are irrigation and domestic. The place of use is WCWCD in Nevada. The reservoir is used to store water that can be released to help achieve Floriston Rates, and for flood control.

C. Stampede Reservoir-Water Right Application No. 15673-Permit No. 11605-Water Right Holder, BOR

The permit is for 126,000 acre-feet of storage from January 1 to December 31 of each year, and for 350 cfs of direct diversion from about April 1 to about November 1 of each year. The point of diversion is at Stampede Dam in Section 28, T19N, R17E, MDB&M. There are numerous points of rediversion in Nevada. The purposes of use are: domestic, municipal, industrial, irrigation, flood control, fish culture, and recreation. Hydroelectric power is generated at the dam incidental to releases made for the approved purposes of use. The place of use is: the Truckee Meadows and Newlands Project areas in Nevada. The reservoir also provides a measure of flood control. Stampede Reservoir currently stores Project Water.

D. Independence Lake-Water Right Application No. 9247-License 4196-Water Right Holder, Sierra Pacific Power Company

The license is for 17,500 acre-feet of storage from about December 1 of each year to about July 1 of the succeeding year. The point of diversion is at the dam in Section 35, T19N, R15E, MDB&M. There are several points of rediversion in Nevada. The purpose of use is municipal. The place of use is the cities of Reno and Sparks, Nevada. Sierra Pacific also claims a pre-1914 appropriative water right, and holds a separate license for generation of hydroelectric power; however, neither of these rights is part of the change petition.

II. CHANGE PETITIONS AND APPLICATIONS

Approval of the change petitions would result in additional points of diversion/ rediversion, purposes of use, and places of use for the post-1914 water rights for the four major reservoirs in Truckee River basin in California. Approval would allow water to be transferred/ exchanged among the reservoirs, such that any designated reservoir could generally be used in lieu of any other designated reservoir. The amount of water that would flow to Nevada would remain unchanged; however, the timing of such flows could change. The change petitions do not seek to serve water in areas where it is not served now under other existing water rights, or for purposes of use that do not already exist; i.e., the change petitions do not seek to expand points of diversions, purposes of use, points of diversions, or places of use beyond those already allowed under other existing water rights. While the timing of some flows may change, reservoir releases for stream flows must be in conformance with Article 9 of TROA. Likewise, the change petition process would not result in changes in water released to meet flows associated with Floriston Rates. Approval of the change petitions is critical for the effective implementation of TROA. A description of each of the change petitions and water right applications follows:

Prosser Creek Reservoir-Points of Rediversion are proposed for M&I use in Nevada, including the Truckee Meadows and Fernley areas. Points of rediversion are proposed for incidental hydroelectric power generation at the Farad, Fleish, Verdi, and Washoe hydroelectric plants. Additional places of use are proposed for M&I uses in the Truckee Meadows and Fernley areas. Hydroelectric plants at Stampede, Farad, Fleish, Verdi, Washoe, and Tracy are proposed to be added to the places of use for the generation of incidental hydroelectric power. The Truckee River system from Prosser Creek Reservoir to and including Pyramid Lake is proposed to be added as a place of use for fish and wildlife protection/enhancement and instream water quality enhancement. In addition, it is proposed that groundwater recharge be approved in any of the areas approved for irrigation and M&I uses. Additional purposes of use proposed are fish and wildlife protection/enhancement, incidental hydroelectric power, groundwater recharge, and instream water quality enhancement.

With the additional water rights appropriation, use of the reservoir would be expanded to allow additional parties (TROA signatory parties and storing parties), and the reservoir owner, to store new categories of water (Credit Water) from water allocated to California, water dedicated to the exercise of *Orr Ditch* Decree water rights, water which would otherwise flow to Pyramid Lake, or project or private waters already in storage.

Boca Reservoir-Additional Points of Diversion and/or Rediversion are proposed. Redistribution of storage is proposed under the water rights for Independence Lake and Stampede and Boca Reservoirs in an amount not to exceed 184,350 acre-feet. Additional points of rediversion are proposed for generation of incidental power at the Farad, Fleish, Verdi, and Washoe hydroelectric plants. Additional points of rediversion for M&I use are proposed in the Truckee Meadows and Fernley areas. M&I use is proposed to be added for the Truckee Meadows and Fernley areas, and generation of incidental hydroelectric power is proposed to be added for the Stampede, Farad, Fleish, Verdi, Washoe, and Tracy hydroelectric plants. Fish and wildlife protection/enhancement, fish culture, and water quality enhancement are proposed to be added at Pyramid Lake. In addition, it is proposed that groundwater recharge be approved for any of the areas approved for irrigation and M&I uses. It is proposed that M&I, stock watering, fish culture, fish and wildlife protection/enhancement, incidental power, groundwater recharge, and instream water quality enhancement be added as purposes of use.

Stampede Reservoir-Additional Points of Diversion and/or Rediversion are proposed. Redistribution of storage is also proposed as described for Boca Reservoir. Additional points of rediversion for generation of incidental hydroelectric power are proposed at the Farad, Fleish, Verdi, and Washoe hydroelectric plants. Additional points of rediversion for M&I use are proposed in the Truckee Meadows and Fernley areas. It is proposed that the Truckee Meadows and Fernley areas be added as places of use for M&I. It is proposed that the Stampede, Farad, Fleish, Verdi, Washoe, and Tracy hydroelectric plants be added as places of use for the generation of incidental hydroelectric power. It is proposed that fish and wildlife protection/enhancement and instream water quality enhancement be added to the Truckee River system from Stampede Dam to, and including, Pyramid Lake. In addition, it is proposed that groundwater recharge be approved for any of the areas approved for irrigation and M&I uses. It is proposed that fish and wildlife protection/enhancement, incidental power, groundwater recharge, and instream water quality enhancement be added as purposes of use.

Independence Lake-Additional Points of Diversion and/or Rediversion are proposed. Redistribution of storage is also proposed as described for Boca Reservoir. Additional points of rediversion for M&I use are proposed to be added in the Truckee Meadows and Fernley areas. Points of rediversion for generation of incidental power are proposed to be added at the Farad, Fleish, Verdi, and Washoe hydroelectric plants. It is proposed that additional areas in Truckee Meadows and Fernley be added to the existing place of use for M&I. It is proposed that the Stampede, Farad, Fleish, Verdi, Washoe, and Tracy hydroelectric plants be added as places of use for generation of incidental hydroelectric power. It is proposed that the Truckee River system from Independence Dam to, and including, Pyramid Lake be added as a place of use for fish and wildlife protection/enhancement and instream water quality enhancement. In addition it is proposed that groundwater recharge be approved for any of the areas approved for irrigation and M&I uses. It is proposed that irrigation, domestic, industrial, stock watering, fish culture, fish and wildlife protection/ enhancement, incidental power, groundwater recharge, and instream water quality enhancement be added as purposes of use.

There are no deletions of points of diversion/rediversion, purposes of use, or places of use included in any of the four petitions.

III. ADMINISTRATIVE PROCESS

SWRCB must consider a number of factors when acting on a change petition:

- That the proposed change will not injure any other legal user of water (California Water Code [CWC], section 1702).

- That the proposed change will not in effect initiate a new right (California Code of Regulations [CCR] title 23, section 791).

SWRCB must also consider a number of factors when acting on an application to appropriate water:

- That unappropriated water is available for appropriation (CWC section1375(d)).

- The instream flows required to protect beneficial uses of water, including uses identified in a water quality control plan (Id. section 1243.5). Beneficial uses include the use of water for recreation and the preservation and enhancement of fish and wildlife (Id. section 1243).

- That the water use, method of use, and method of diversion are reasonable, in accordance with article X, section 2 of the California Constitution. (See also CWC, section 275.)

- The effect of the project on public trust resources and protection of those resources where feasible.

Evaluation of the environmental effects of the above actions should consider the following:

- Effects on changes in flows as they relate to fishery, riparian habitat, and water quality issues.
- Effects on adding to places of use.
- Effects of adding purposes of use.
- Miscellaneous: effect on other legal users of water. Economic or social effects of a project shall not be treated as a significant effect on the environment, but may be used to determine the significance of the physical changes caused by the project (CCR, title 14, section 15131(a)-(b)).

IV. SUMMARY OF EFFECTS

This revised DEIS/EIR has identified the following effects relative to TROA and Change Petitions and Application for the various resources addressed.

A. General Effects Associated with TROA

TROA's effect on riparian habitats along the mainstem of the Truckee River from Lake Tahoe to the Little Truckee River, when compared to current conditions, would vary depending on hydrologic conditions. In wet hydrologic conditions, no difference is identified for this entire section. In median hydrologic conditions, no difference is identified for the reach of Donner Creek to the Little Truckee, but in the reach from Lake Tahoe to Donner Creek, a significant beneficial effect is identified for TROA. In dry hydrologic conditions, no difference is identified for the reach from Lake Tahoe to Donner Creek, but in the reach from Donner Creek to the Little Truckee, a significant beneficial effect is identified for TROA. In very dry hydrologic conditions, TROA would have a significant beneficial effect on riparian habitat in this entire reach.

TROA would have no significant adverse effect on special status animals associated with riverine habitats along the mainstem of the Truckee River or any of the affected tributaries. TROA would provide significant benefits to both riparian habitat and riparian-associated plant and animal species in most hydrologic conditions.

Flows for rafting and kayaking would be the same under TROA, No Action, and current conditions, and effects would be the same as under No Action.

B. General Effects of Change Petitions and Applications

Approval of these change petitions and water right applications would not result in any new uses of water or use of water in additional areas. While new purposes and places of use are being added to the permits, no new additions are being made to the existing operation of the designated Truckee River reservoirs. Under TROA, Truckee River reservoirs would continue to be operated within their current operational footprints. Because of these factors and because the minimum instream flows required in Article 9 of TROA would remain in effect, approval of these change petitions and water right applications would not result in any significant adverse environmental effects. The specific environment effects at Prosser Creek, Stampede, and Boca Reservoirs and Independence Lake related to the change petitions and water right applications are summarized as follows.

1. Prosser Creek Reservoir/Creek

Future storage operations under TROA would not exceed the current footprint of the reservoir.

At Prosser Reservoir, in median hydrologic conditions, operations model results show that storage would generally be greater from April through September. For Prosser Creek, flows would be lower in May and June, but much higher in September and October. In wet hydrologic conditions, storage and releases would be the same as under No Action, but in dry hydrologic conditions, storage would be much greater. Releases in dry hydrologic conditions would be lower in May and June, but much higher in September and October.

The frequency of achieving preferred flows in Prosser Creek for rainbow trout with approval of the change permits and the water right appropriation is 10 percent greater when compared to No Action or current conditions. This difference would enhance spawning, incubation, and rearing of rainbow trout in this reach.

Generally, approval of the new appropriation would promote conditions in the reservoir to improve fish survival and spawning habitat over current conditions.

The additional storage allowed by the new appropriation would increase visitor usage at Prosser Creek Reservoir when compared to No Action or current conditions. Boat ramp usability would be the same with or without the new appropriation.

Flows for recreational fishing in Prosser Creek would be slightly better with approval of the change permits and the water right appropriation when compared to No Action or current conditions.

2. Stampede Reservoir/Little Truckee River

BOR has filed temporary applications with SWRCB for storage and diverted water to storage in Stampede Reservoir to its maximum capacity of 226,500 acre-feet. Operations model results show that under TROA, the ability to store water in excess of the currently permitted annual amount in Stampede Reservoir would only occur in 3 out of 100 years. Future storage operations under TROA would not exceed the footprint of the reservoir. The same amount of water would flow to Pyramid Lake with or without approval of the application to appropriate additional water in Stampede Reservoir; however, TROA would change the timing of releases that would enhance aquatic and riparian resources in the lower Truckee River.

At Stampede Reservoir in median hydrologic conditions, storage would be much greater under TROA. Releases from Stampede Reservoir would be lower from November through August, but much higher in October. In wet hydrologic conditions, under TROA, reservoir storage would be greater from May through September, and releases would be higher from September through December. In dry hydrologic conditions, storage and releases would be much greater year-round under TROA. Minimum flows for brown trout would be sustained more than 4 times more frequently under TROA than under No Action, and 3 times more frequently than under current conditions.

Generally, approval of the change permits and the water right appropriation would result in improved conditions in the reservoir for fish survival and spawning habitat compared to current conditions.

Recreational usage at Stampede Reservoir would be slightly higher with the approval of the change permits and the water right appropriation than under current conditions and No Action. Boat ramp usability would be the same as under No Action and current conditions.

Flows for recreational fishing in the Little Truckee River also would be the same as under No Action or current conditions.

3. Boca Reservoir

Future storage operations under TROA would not exceed the footprint of the reservoir.

In median hydrologic conditions, storage would be greater under TROA from August through March. In wet hydrologic conditions, with approval of the change permits, reservoir storage would be greater storage from October through December and lower in August. In dry hydrologic conditions, storage would be greater year-round with approval of the change permits.

Generally, approval of the change permits would enhance conditions in the reservoir for fish survival and spawning habitat when compared to current conditions.

4. Independence Lake/Creek

Future storage operations under TROA would not exceed the current footprint of the reservoir.

Independence Lake storage and releases would generally be the same with approval of the change permits when compared to No Action. In dry hydrologic conditions, operations model results show that storage would be greater with approval of the change permits from July through September, and less during November through June. In dry hydrologic conditions, releases would be higher from May through September. Approval of the change permits would result in a number of potential benefits to fishery resources at Independence that would not occur otherwise. For example, TROA calls for action to be taken by CDFG to ensure that the delta at the upper end of the lake remains open for fish passage. Also, TROA could improve the timing and duration of flows in Independence Creek by removing current constraints to improve flows in Independence Creek during summer months.

With approval of the change permits, the brown trout fishery in Independence Creek has the potential to increase successful reproduction as compared to No Action or current conditions.

Preferred flows for rainbow trout likely would occur more frequently with approval of the change permits. Lethal flow conditions would occur significantly less frequently with the approval of the change permits, and rainbow trout spawning, incubation, and rearing would be enhanced.

Flows for recreational fishing in Independence Creek would be the same as under No Action and current conditions.

GROWTH-INDUCING IMPACTS

Section 21100(b)(5) of CEQA requires an EIR to discuss the growth-inducing impact of a proposed project. Section 15126.2(d) of the CEQA Guidelines clarifies this requirement, stating that an EIR must address "the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment."

Growth inducement may not necessarily be considered detrimental, beneficial, or of insignificant consequence under CEQA. Induced growth is considered a significant impact only if it affects, directly or indirectly, the ability of agencies to provide needed public services or if it can be demonstrated that the potential growth, in some other way, significantly affects the environment.

Generally speaking, a project is considered growth inducing when it:

- Directly or indirectly fosters (1) economic growth, (2) employment opportunities, (3) population growth, or (4) additional housing.

- Removes obstacles to growth.

- Burdens community infrastructure and service facilities (transportation, fire and police protection, schools, recreation facilities).

- Encourages or facilitates other activities that could significantly affect the environment.

In addition, NEPA regulations require an EIS to consider the potential indirect impacts of a proposed project. Indirect effects of an action include those that occur later in time or farther away in the distance but that are still reasonably foreseeable (CEQ Guidelines section 1508.8(b)).

This section also notes that indirect effects can include "growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems."

Future population levels and water demands used in this revised DEIS/EIR are based on projections made by State and regional service and planning entities responsible for planning for M&I water supply and demand in the Lake Tahoe and Truckee River basins. For Truckee Meadows, these entities are Washoe County and Truckee Meadows Water Authority. For the California and other Nevada portions of the Lake Tahoe and Truckee River basins, these entities are California Department of Finance, California Department of Water Resources, Tahoe Regional Planning Agency, Nevada Division of Water Resources, city of Fernley, and the Pyramid Tribe. These entities have prepared extensive studies and reports variously forecasting the study area's economy, population, and resources. These studies and reports have been approved and adopted by the respective agencies, in cooperation with local jurisdictions, as the most likely scenarios for growth in these regions. Projections made by local planning entities indicate that population growth during the study period would be the same with or without the Federal action (TROA). Therefore, implementation of TROA would not be growth-inducing in the Lake Tahoe or Truckee River basins.

Although sources of water or mechanisms to meet water demands might differ among the alternatives, population growth and resulting water demand are projected to be the same under No Action, LWSA, and TROA. (See “Water Resources” and “Social Environment.”) The projected changes are within the parameters of planning for growth within the study area, including land use, transportation, housing, schools, public services, environmental resources, and infrastructure planning. (Note: few planning efforts extend 29 years into the future; however, all alternatives are compatible with projected trends and below the threshold of substantial impact.)

ENVIRONMENTAL JUSTICE

As mandated by Executive Order 12898, published February 11, 1994, entitled “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” this section—along with the “Economics,” “Social Environment,” and “Indian Trust Resources” sections and chapter 5, “Consultation and Coordination” section—addresses potential environmental justice concerns. The specific requirements of the Executive order are that Federal agencies identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low income populations.

As part of this study process, public involvement, Indian trust resources consultation, and coordination with potentially affected publics continue. (See “Indian Trust Resources.”) Neither LWSA nor TROA involves facility construction, population relocation, health hazards, hazardous waste, property takings, or substantial economic impacts. Implementing LWSA or TROA is not projected to have an adverse human health or environmental effect as defined by environmental justice policies and directives.

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are assumed to be long-term impacts to resources which would be affected by implementation of one of the action alternatives. Because the action alternatives involve only modifying reservoir operations, no unavoidable adverse impacts are expected.

RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

In the short term, implementing TROA is projected to cause operational changes that will result in more system flexibility to meet long-term future needs. Because of exchange and storage agreements that are components of TROA, a more assured long-term drought water supply for Truckee Meadows would be obtained, and improved flow conditions would be possible for the endangered and threatened Pyramid Lake fishes and aquatic species in general. California's allocation of water for M&I purposes in the long-term will be assured and can be utilized in the short term to improve environmental conditions in the Truckee River.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable commitments are considered to be the permanent reduction or loss of a resource. No irreversible and irretrievable commitments of resources would occur under any of the alternatives.